



SAM/IG/12

INTERNATIONAL CIVIL AVIATION ORGANIZATION
South American Office

Regional Project RLA/06/901

**TWELFTH WORKSHOP/MEETING OF THE SAM
IMPLEMENTATION GROUP**

(SAM/IG/12)

FINAL REPORT

Lima, Peru, 14 to 18 October 2013

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HISTORY OF THE MEETING

ii-1 PLACE AND DURATION OF THE MEETING

The Twelfth Workshop/Meeting of the SAM Implementation Group (SAM/IG/12) was held at the premises of the ICAO South American Regional Office in Lima, Peru, from 14 to 18 October 2013, under the auspices of Regional Project RLA/06/901.

ii-2 OPENING CEREMONY AND OTHER MATTERS

Mr. Franklin Hoyer, Regional Director of the ICAO South American Office, greeted the participants for the continuous support provided to activities developed at regional scale by the South American Office, as well as the civil aviation authorities and national and private organizations of the ICAO South American Region for the continuous support to the activities of the SAM Implementation Group.

ii-3 SCHEDULE, ORGANIZATION, WORKING METHODS, OFFICERS AND SECRETARIAT

The Meeting agreed to hold its sessions from 09:00 to 15:30 hours, with appropriate breaks. The work was done with the Meeting as a Single Committee, Working Groups and Ad-hoc Groups.

Mr. Luiz Ricardo de Souza Nascimento, delegate from Brazil, was unanimously elected as Chairman of the Meeting. Also, Mr. Paulo Vila Millones, delegate from Peru, was elected as Vice-Chairman.

Mr. Onofrio Smarrelli, RO/CNS SAM Office, Lima, acted as Secretary assisted by Messrs. Roberto Arca, RO/ATM/SAR/AIM, and Marcelo Ureña, RO/FLS.

In addition, the Secretariat counted with the support of Messrs. Julio Pereira, Rapporteur of the Airspace Optimization Group; Blas Enrique Espinoza and José Mondragón, Rapporteurs of the ATFM Group; Omar Gouarnalusse, Rapporteur of the CNS Group; and Andrés Jansen and Murilo Albuquerque Loureiro, Rapporteurs of the Automation Group.

ii-4 WORKING LANGUAGES

The working language of the Meeting was Spanish.

ii-5 AGENDA

The following agenda was adopted:

Agenda Item 1: Follow up to conclusions and decisions adopted by SAM/IG meetings and presentation of a format proposal for next SAM implementation group meetings

Agenda Item 2: Optimization of the SAM airspace
a) En-route PBN
b) PBN in terminal areas
c) PBN procedures

- Agenda Item 3: Criteria and procedures for the approval of performance-based navigation operations
- Agenda Item 4: Air Traffic Flow Management Implementation (ATFM) in the SAM Region
- Agenda Item 5: Assessment of operational requirements in order to determine the implementation of communications, navigation, and surveillance (CNS) capabilities improvement for en-route and terminal area operations
- Agenda Item 6: Operational implementation of new ATM automated systems and integration of the existing systems
- Agenda Item 7: Other business

ii-6 ATTENDANCE

The meeting was attended by 52 participants from 10 States of the SAM Region (Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Panamá, Paraguay, Peru and Venezuela), 2 International Organizations (IATA and SITA) and 4 observers (ATECH, INDRA, SKYSOFT and NAVANS). The list of participants is shown in page iii-1.

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Agenda Item 1: Follow up to conclusions and decisions adopted by SAM/IG meetings and presentation of a format proposal for next SAM implementation group meetings

1.1 Under this Agenda Item, the Meeting reviewed WP/02 - *Review of the status of compliance of conclusions formulated by SAM/IG meetings and pending activities* (Secretariat) and WP/03 - *Proposal of new agenda for SAM/IG meetings* (Secretariat).

Review of the status of compliance of conclusions formulated by SAM/IG meetings and pending activities

1.2 The Meeting reviewed the status of implementation of the valid conclusions and tasks generated by SAM meetings, as well as their follow-up, whose results are shown in **Appendices A and B** to this Agenda Item.

Format proposal for next SAM implementation group meetings

1.3 The Meeting took note that the next SAM/IG meetings should include all the ASBU Block 0 modules taken under consideration for their implementation in the SAM Region in the *Air Navigation System Performance-Based Air Navigation System Implementation Plan for the SAM Region* (PBIP) (Version 1.3).

1.4 In this respect, the Meeting was informed of all the topics that should be considered upon in the next SAM/IG meetings, which are shown in **Appendix C** to this Agenda Item.

1.5 The Meeting deemed it unviable to consider all the subjects within an only SAM/IG agenda, in view of their range and multidisciplinary character. Therefore, it agreed that the regional implementation priorities indicated by the States of the Region would define the agenda items for the next SAM/IG meetings. The SAM Region implementation priorities will be presented for initial approval at the Meeting of Air Navigation and Flight Safety Directors of the SAM Region (Lima, 21 to 22 October 2013).

1.6 The Meeting recalled that SAM/IG meetings are a forum in which specialists from the various aeronautical disciplines involved in the subjects of the agenda draft action plans, provide support and follow-up on the implementation of the systems, services and procedures for the improvement of efficiency and air navigation capacity in the SAM Region, while keeping the high safety standards required.

1.7 The Meeting considered that, even though the agenda topics as well as the air navigation areas to be covered would be expanded, the SAM/IG meetings should continue being held twice a year, thus avoiding increasing their number per year.

1.8 Finally, the Meeting deemed it convenient that the coordination committee meetings (RCC) of project RLA/06/901, carried out every November, be the forum where SAM/IG agendas for the next year are approved upon.

1.9 On the basis of the afore indicated considerations, the Meeting formulated the following conclusion:

Conclusion SAM/IG/12-1 Agenda proposal for next SAM/IG meetings

That, the agenda proposal for the next SAM/IG meetings:

- a) Respond to current regional implementation priorities defined by the States of the Region on the basis of the subjects indicated in Appendix C to this Agenda item, which takes under consideration all the ASBU Block 0 modules in the SAM PBIP;
- b) Is presented every year for the approval of the coordination committee meetings of Project RLA/06/901; and
- c) Be developed through no more than two meetings per year, with the participation of the specialists required and in accordance with the agenda items under consideration.

APPENDIX A

STATUS OF APPLICATION OF CONCLUSIONS AND/OR TASKS ORIGINATED IN SAM/IG MEETINGS

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
1. ATS Routes Implementation							
1-3	UM 662 Guayaquil – Madrid	<ul style="list-style-type: none"> • Coordinate the implementation. • Issue AIC. • Train personnel. • Amend CAR/SAM ANP. 	Route implemented		States Secretariat	RO/ATM RO/AIM	COMPLETED Route Guayaquil-DAREK has been implemented.
2. Optimisation of ATS routes in the SAM Region							
2-4	Handling of air transport environmental problems	Obtaining of objective data over benefits that will be reached in terms of reduction of harmful gas emissions into the atmosphere.	<ul style="list-style-type: none"> • Known data. • Availability of information required for monitoring of environmental protection. 	SAM/IG/9	States	N/A	VALID Check fuel savings estimate chart. Permanent task.
2-5	Prepare a measurable plan of performance, including gas emissions safety, efficiency, etc.	<ul style="list-style-type: none"> • Check available tools to carry out this task. • Prepare a measurable plan. 	A measurable plan will be available which will permit a clear vision of the current and future status of performance regarding gas emissions, safety and efficiency.	SAM/IG/9	RLA/06/901	RO/ATM	VALID This task was included in the review of the action plan for the optimization of the SAM airspace, developed at SAM/IG/11 meeting.

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
2-19	<p>Conclusion SAM/IG/7-1 - ATS routes network optimisation programme of the South American Region, Phase 3, Version 02</p> <p>That ICAO SAM States take pertinent actions to follow the guidelines and comply with established deadlines to continue with Phase 3, Version 02 of the ATS routes network optimisation programme of the South American Region, shown in Appendix A to this part of the report.</p>	See ATS routes network optimisation programme, Version 02 (SAM/IG/7)	Version 02 ATS routes network optimisation	As per action plan	States RLA/06/901 IATA Regional Office	RO/ATM RO/AIM	<p>VALID</p> <p>The task regarding the review of the action plan for the optimization of the SAM Airspace, developed at SAM/IG/11 meeting, has been included. Phase 3, Version 02 has been divided into stages. Implementation date for first stage is 12 December 2013.</p>
2-20	<p>Conclusion SAM/IG/10-1 - Safety Plan for the implementation of routes Phase 3, Version 02</p> <p>That SAM Region States determine the viability of the SAM ATS Route Network optimization (ATSRO) Programme, based on a risk assessment, in order to ensure safety within their FIRs.</p>	Determine viability of ATSRO Programme.	Result of risk assessment within considered FIR	ATS/RO/5	SAM States		<p>VALID</p> <p>States approved implementation by stages in ATSRO/5 Meeting.</p>

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
2-22	<p>Conclusion SAM/IG/11-2 - Implementation of the concept on the flexible use of the airspace in the ICAO SAM Region That States of the SAM Region use the Guidance Manual for the implementation of the concept on the flexible use of the airspace in the SAM Region for the design and management of the flight information regions airspaces under their jurisdiction, appearing under SAM/IG/10 report, Agenda Item 2, Appendix E</p>	Operational improvements related with airspace optimization	National plan for the optimization of the airspace with the use of FUA	SAM/IG/13	SAM States		<p>VALID The task of developing all the required guide material, as well as the Action Plan Model and other documentation, has been fulfilled in the Region.</p>
3. Implementation of Performance Based Navigation (PBN) in the SAM Region							
3-17	<p>Conclusion SAM/IG/5-4 Implementation of Continuous Descent Operations That, recognizing the efficiency and environmental benefits of Continuous Descent operations, and the need to harmonize these operations in the interest of safety, States are encouraged to include the implementation of Continuous Descent operations (CDO) as part of their PBN implementation plans and to implement CDO in accordance with the ICAO CDO Manual.</p>	States should include in their PBN programmes the CDO concept.	CDO implemented as per national requirements.	SAM/IG/10	States	RO/ATM	<p>VALID Some States introduced CDO in their national plans, but these not appear as such in the publications.</p>

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
3-18	<p>Conclusion SAM/IG/11-1 – Support to the SAM States in the redesign of their TMAs That, Project RLA/06/901 consider the viability of:</p> <p>Replicate the Course/Workshop on Airspace Design at the Lima Regional Office for one week, with an intensive schedule, with experts of the Region, Project and IATA instructors, that have already offered their support to this initiative; and</p> <p>Create a support team to assist a group of States that are aligned in their traffic flows, in the development of a basic design aimed at main international airports.</p>	Conduct courses on PBN design in terminal areas for the SAM Region, in the Lima Regional Office.	Base design of selected terminal areas, in order to allow States to deepen and implement new TMAs based on PBN design.	December 2014	RLA/06/901 Project	ATM/ROs and Miami Course instructors	VALID

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
3-19	<p>Conclusion SAM/IG/11-2 – Implementation of the concept of the Flexible Use of the Airspace in the SAM Region</p> <p>That, the States of the SAM Region use the Guidance for the implementation of the Concept of the Flexible Use of the Airspace in the SAM Region, shown in Appendix E to the item 2 of the SAM/IG/10 Meeting, for the design and management of the airspace of the Flight Information Regions under its jurisdiction.</p>	<p>Implement Coordination and Civil-Military Cooperation Committees.</p> <p>Coordinate flexible use of prohibited, restricted and dangerous areas affecting the airspace optimization.</p>	<p>Optimized prohibited, restricted and dangerous areas.</p>	2014	States	RO/ATM	VALID
3-23	<p>Conclusion SAM/IG/6-3 -</p> <p>That SAM States take pertinent action in order to apply forms CMA F5 and CMA F6, attached as Appendices A and B to this part of the report, and send them to CARSAMMA as soon as the PBN approval of aircraft and operators is established.</p>	<ul style="list-style-type: none"> • Use Forms CMA F5 and CMA F6. • Taking into consideration that some listings contain all data foreseen in such form, and in such cases, the meeting concluded that the submission of the corresponding F5 forms is not necessary. In cases in which the lists do not contain information foreseen in Form F5, States should send them to CARSAMMA. 	<p>Safe RNAV5 implementation.</p>	<p>First Phase October 2011</p>	States	RO/ATM	<p>VALID</p> <p>States should implement procedures to keep data base updated.</p>

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
3-25	<p>Conclusion SAM/IG/6-5 - Lateral navigation deviation reporting form That SAM States take the corresponding action in order to use the monitoring programme and particularly lateral navigation deviation reporting form attached as Appendix F to this part of the report, and send it to CARSAMMA on the tenth day of each month.</p>	Collect information of lateral deviations and send it to CARSAMMA	Safe RNAV5 implementation.	SAM/IG/10	States	RO/ATM	<p>VALID The Secretariat will coordinate on the validity of this Conclusion with CARSAMMA.</p>
4. Standards and procedures for performance based navigation operations approval							
4-11	<p>Para 4.9 SAM/IG/6 report- Establish standard criteria for the Regional System on ground and flight Validation of flight procedures through satellite-based PBN instruments.</p>	Prepare standardised criteria.	Uniform application of Validation criteria on ground and flight procedures through satellite-based PBN instruments.	SAM/IG/9	RLA/99/901	RO/FS	<p>VALID The draft CA 91-012 – Flight validation (FV) of satellite-supported instrument flight procedures (IFP) of performance based navigation (PBN) was presented during the SAM/IG/6. To this respect, the Meeting requested the Secretariat to send a survey of flight inspection experts for comments and further approval. The Secretariat will consult with SAM RO/FLS on the status of this Conclusion.</p>

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
5-11	<p>Conclusion SAM/IG/5-7 ATFM Teleconferences in the SAM Region</p> <p>That SAM States continue to hold weekly ATFM teleconferences between flow management units or flow management positions (FMU / FMP) to improve the exchange of information among participating States.</p>	Implement ATFM teleconferences	Coordination between FMU/FMP carried out.	SAM/IG/8	States	RO/ATM	<p>VALID</p> <p>States maintain web conferences due to communication problems in TELCONs held. The use of SKYPE and go-to-meeting is planned. REDDIG II includes a speech communications sub-network to support this application. Weekly teleconferences are not being held, but various States transmit the teleconference format by e-mail.</p>
5-16	<p>Conclusion SAM/IG/6-8 ATFM AIP SUPP/AIC Model</p> <p>That the States of the ICAO South American Region, when preparing their national AIC, use as a reference the ATFM AIP SUPP/AIC model shown in Appendix E to this part of the report.</p>	Prepare AIC	Harmonised publications in the SAM Region	December 2012	States	RO/ATM	<p>VALID</p>
5-18	Message exchange in the ATFM manual be prepared as a MOU among States to be included in the ATFM Manual.	Preparation of MOU for ATFM messages exchange among States.	MOU prepared and approved.	SAM/IG/10	States Regional Project RLA/06/901	RO/ATM RO/CNS	<p>VALID</p>

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
5-19	Preliminary exercise on runway capacity and ATC sectors. The remaining States are encouraged to present their studies for SAM/IG/8.	Carry out a preliminary study on runway capacity and ATC sectors.	Present studies on exercises carried out	SAM/IG/12	States	RO/ATM	VALID

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
6. Assessment of operational requirements in order to determine the implementation of communications and surveillance (CNS) capabilities improvement for en-route and terminal area operations							
6-7	<p>Conclusion SAM/IG/6-9 - Actions required for AMHS interconnection That SAM States, in view of the delays in the interconnection of the AMHS, proceed with the following actions:</p> <ul style="list-style-type: none"> a) Require from their AMHS providers the necessary support to successfully end the necessary interconnections; b) Make necessary arrangements to train personnel in the interconnection tasks, with the aim of minimizing the dependency with their providers; c) Maximize pertinent coordination; and d) States that have not yet done so, complete the drafting and signature of the MoU. 	Interconnection of CNS systems	Interconnection of AMHS	End of 2013	SAM States	SAM States AMHS providers RO/CNS	<p>COMPLETED</p> <ul style="list-style-type: none"> a) Completed. Coordination has been carried out with providers to complete the interconnection. b) Completed. In July 2012 an AMHS course was carried out by EUROCONTROL's INSTILUX center; from 24 to 28 July 2013 a second course will be carried out by the same Institute. c) Completed. Coordination has been increased. d) Even though AMHS interconnection MoUs are pending, States involved have approved goals to complete AMHS interconnection, indicated in SAM/IG/10-WP/10, Appendices A and B

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
6-12	SAM/IG/10 Report paragraph 5.1, to complete safety guidelines for the implementation of IP networks and IP router policy.	Complete safety guidelines for the implementation of IP networks and IP router policy.	Safety guidelines of IP networks document. IP router policy document.	SAM/IG/11	Project D1	RO/CNS	COMPLETED SAM/IG/11 meeting examined same, and were later submitted to States for their review. Comments were only received from Bolivia, which were incorporated into the guides. Therefore, same have been approved.
6-13	Conclusion SAM/IG/11-4 - International AMHS interconnection That, with regard to international operational AMHS interconnections, if bilateral arrangements conducted by States do not permit another solution, same should make adjustments in their systems in order that they are compatible with mode TP0 as a whole and in accordance with Regulation RFC 1006.	Compatibility with mode TP0 at AMHS installed	AMHS compatible with mode TP0	2016	States	RO/CNS	SUPERSEDED By Conclusion SAM/IG/12-4

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
6-14	<p>Conclusion SAM/IG/11-5 - Use of the radio frequency spectrum That, the States of the SAM Region:</p> <p>a) Ensure the VSAT networks operating in the band between 3.4 to 4.2 Ghz with regard to the IMT services, informing of any interference to both the pertinent national entity and the ICAO SAM Regional Office;</p> <p>b) Examine lists COM 1 to 3 and confirm the use of the frequencies assigned, notifying of any changes therein; and</p> <p>c) Count with a mechanism agreed upon with the national authority enabling detection and solving the use of unauthorized transmissions causing inconveniences to the aeronautical services.</p>	<p>a) Inform on the interference in 3.4 to 4.2 Ghz band</p> <p>b) Examine lists COM 1, 2 and 3</p> <p>c) Mechanism to enable detection and solution to interferences presented</p>	<p>a) 3.4 to 4.2 Ghz band interference free</p> <p>b) Lists COM 1, 2 and 3 updated</p> <p>c) Establishment of mechanisms to detect and solve interference problems</p>	Continuous activity	States	RO/CNS	<p>COMPLETED</p> <p>As it is a continuous activity, the Secretariat will make follow-up, inviting States to keep the ICAO SAM RO informed on the topics taken under consideration in parts a) b) and c) of this Conclusion</p>
7. Operational implementation of new ATM automated systems and integration of the existing systems							
7-1	<p>SAM/IG/3-8 - Preparation of specific implementation plans for the interconnection of automated systems That States of the SAM Region start the development of specific plans for the implementation of automated systems interconnection, considering</p>	Operational implementation of ATM automated systems and interconnection of automated systems installed between adjacent ACCs.	Memorandum of Understanding (MoU) between SAM pairs of States for the interconnection of automated systems.	2012	SAM States	RO/CNS RLA/06/901 Project automation experts	<p>COMPLETED</p> <p>Most States of the Region with automated systems installed at their ACCs have issued plans taking into account the guide material prepared by SAM/IG with the support of RLA/06/901 Project. States pending</p>

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
	<p>the implementation dates indicated in Regional Interconnection Plan for Automated Systems in adjacent ACCs, specified in Appendix B of this part of the Report, and information contained in the following documentation:</p> <ul style="list-style-type: none"> a) Memorandum of Understanding for the implementation of automated systems interconnection between two States having adjacent ACCs, Interface Control Document (ICD) for data communication between ATS dependencies in Caribbean and South American Regions (CAR/SAM ICD); b) Interface control document (ICD) for data communications between ATS units in the Caribbean and South American Regions (CAR/SAM ICD); c) System Interface Control Document (SICD); and d) Regional interconnection initial plan for ACC automated systems. e) Preliminary reference system/ subsystem specification for the air traffic control automation system (SSS). 						<p>implementation of their plans, have taken note of the guideline material drafted by SAM/IG.</p>

APPENDIX B

FOLLOW-UP OF CONCLUSIONS AND PENDING TASKS OF THE SAM/IG MEETING

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
1-1 SAM/IG/1-1 CAR/SAM PBN Roadmap That ICAO SAM States, in implementing RNAV/RNP, take the pertinent actions to follow guidelines contained in the CAR/SAM PBN Roadmap as shown in Appendix C to this part of the report.	YES	YES	YES	YES	YES	O/G	--	YES	O/G	YES	YES	YES	YES	YES	PER: Dec 2009
1-1 That States examine: a) Impact of RNAV routes implementation in the airspace Aircraft fleet, Air traffic services, and b) Establish pertinent coordination so as to enable integrated, harmonious and timely implementation of more direct RNAV routes.	O/G	O/G	YES	YES	YES	O/G	--	O/G	O/G	O/G	YES	O/G	YES	YES	COL: June ECU: Local coordination with corresponding area. PAR: SAM/IG/ 5 PER: SAM/IG/5 VEN: Mar 2010
2-1 Implementation of RNAV routes	YES	YES	YES	YES	YES	YES	--	YES	YES	YES	YES	YES	YES	YES	
2-3 Conclusion SAM/IG/2-1 PBN implementation Programme for en-route operations That the ICAO SAM States take appropriate actions to follow the guidelines and comply with the targets established in the PBN implementation for en-route operations, which is shown in Appendix B to this part of the Report.	YES	YES	YES	YES	YES	--	--	YES	YES	YES	OG	YES	YES	YES	PER: Nov 2010

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
<p>2-10 Conclusion SAM/IG/2-2 Initial AIC That States of ICAO SAM Region using as model the AIC presented in Appendix C to this part of the Report:</p> <p>a) publish in the AIRAC date of 9 April 2009 an Aeronautical Information Circular (AIC) informing the aeronautical community on their intention to implement RNAV 5 on 18 November 2010;</p> <p>b) reflect in this AIC the specific YESituations within the airspace under their jurisdiction.</p>	YES	YES	YES	YES	YES	YES	--	YES	YES	YES	YES	O/G	YES	YES	GUY: Nov. 2009 SUR: Will inform 15 Nov. 2009
<p>2-12 Conclusion SAM/IG/2-3 Survey on the Fleet Navigation Capacity That States conduct a survey on the fleet navigation capacity, using, to that end, the form contained in Appendix D to this part of the Report, and send the information collected to the ICAO South American Regional Office, on the following dates:</p> <p>a) Aircraft operating commercial flights, which have more than 5 700 kg. of MTOW – 15 February 2009;</p> <p>b) Aircraft operating commercial flights, which have less than 5 700 kg. of MTOW – 15 May 2009;</p> <p>c) Other aircraft registered in the Region–15 Aug 2009.</p>	YES	YES	YES	YES	YES	YES	--	YES	O/G	YES	YES	O/G	YES	YES	COL: Initially had same problem as Venezuela but after holding PBN seminars we have started the approval process. PAR: completed a) pending b) and c). VEN: fruitless surveys have been carried out in view of the little knowledge that operators and aircraft owners have on PBN concept. A dissemination campaign is being carried to, to enable the improvement of data provided by the same.
<p>2-13 1.2 1.2 Collect air traffic data to understand air traffic flows in a specific airspace.</p>	YES	NO	YES	YES	YES	YES	--	YES	O/G	YES	YES	YES	YES	YES	PER: carried out Jul 2009. Delivered to SAM Office.

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
2-14 Conclusion SAM/IG/2-4 PBN Implementation Model for TMA and Approach That States/Territories and International Organizations use the PBN Implementation Model for TMA and Approach in the preparation of their PBN implementation programmes for TMA and Approach, shown in Appendix E, item 2 SAM/IG/2 Report.	YES	O/G	YES	YES	YES	O/G	--	YES	O/G	YES	YES	O/G	YES	YES	ECU: Developing. PER: Dec 2009, this model is being used. SUR: 15 Nov 2009. VEN: 18 Nov 2010.
3-1 Conclusion SAM/IG/2-5 Advisory Circular CA 91-002 and Job Aid for Aircraft and operators RNAV 5 operational approval That States of ICAO South American Region: a) Use as an acceptable compliance source in aircraft and operators RNAV 5 operational approval Advisory Circular CA 91-002 and Job Aid for Aircraft and operators RNAV 5 operational approval, presented in Appendices A and B, respectively, to this part of the Report. b) Publish respective national regulations up to April 2009.	YES	YES	YES	YES	YES	O/G	--	O/G	O/G	YES	YES	--	YES	YES	COL: Information circular was published and may be seen at the hyperlink: CI 5102-082-002 ECU: Coord. with OPS PER: Dec 2009 BRA and PAN: publication is being harmonized with CA LAR. PAR: signature pending Oct. 2010.
3.5 Conclusion SAM/IG/3-3 PBN Implementation National Plans That States of ICAO South American Region, present their PBN Implementation National Plans to SAM/IG/4 Meeting, using PBN Implementation Plan Model, shown in Appendix B of this part of the Report, as well as using the action plan models and information contained PBN Implementation Project TMA Operations and Short Term Approximations of SAM Region, approved by SAM/IG/2 Meeting.	YES	YES	YES	YES	YES					YES	YES		YES	YES	BOL: delivered Dec. 2009. VEN: finalised and delivered.

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
<p>4-2 Conclusion SAM/IG/2-6 ATFM Roadmap That, a) the ATFM Roadmap in Appendix B to this part of the Report be adopted, with the aim of providing orientation to the ATFM community with regard to ATFM applications to be implemented in the short and medium term in the SAM Region; and b) the ICAO Secretariat send the ATFM Roadmap to the GREPECAS ATFM Task Force for the analyses and actions deemed pertinent.</p>	O/G	O/G	YES	YES	YES	O/G	--	O/G	O/G	YES	NO	O/G	YES	YES	ECU: ATFM. PER: Mar 2010.
<p>4-5 Initial ATFM AIC Model</p>	YES	YES	N/A	NO	YES	YES	--	YES	O/G	YES	YES	O/G	YES	YES	BRA: information published in the AIP. GUY: 22 Oct 2009.
<p>Conclusion SAM/IG/3-1 ATS Route Network Optimising in the South American Region That the ICAO SAM States take relevant action to follow the guidelines and meet the target dates established in the ATS Route Network Optimising Programme in the South American Region that appears in Appendix B to this part of the report.</p>	YES	YES	YES	YES	O/G	--	--	--	--	YES	YES	--	YES	YES	VEN: pertinent actions taken.
<p>Conclusion SAM/IG/3-4 Advisory Circulars CA 91-008, CA 91-009 and CA 91-010 That States of the SAM Region: a) use as acceptable means of compliance in aircraft approval and exploiters for RNP APCH, RNP AR APCH and APV/Baro-VNAV operations, Advisory Circulars CA 91-008, CA 91-009 and CA 91-010, shown in Appendices B, C and D, respectively to this part of the report; and b) publish the corresponding national regulations until 5 October 2009.</p>	O/G	YES	SI	YES	YES	O/G	O/G	O/G	O/G	YES	YES	O/G	YES	YES	BOL: published in RAB91 COL: published the following information circular: CI-5102-082-008 CI-5102-082-009 CI-5102-082-010 PAR: in final process of publication. VEN: published in September 2010 CA RNAV5, RNP-1, RNP AR APCH and APV-BARO/VNAV.

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
<p>3-5 Conclusion SAM/IG/3-5 Runway capacity of an international airport and ATC associated sector</p> <p>SAM States are encouraged to carry out at least an exercise to determine the runway capacity of an international airport and ATC sector, associated or another one selected for each State, to present the results to the SAM/IG/4 Meeting, providing the following information:</p> <p>a) Amount of personnel trained for the exercise b) Methodology applied c) Result of the exercise, providing the declared capacity for each runway and ATC selected sector. d) Identification of problems found in the methodology applied.</p>	O/G	YES	YES	YES	YES	YES	--	--	--	YES	YES	--	NO	YES	<p>ECU: has trained personnel and calculation Quito and Guayaquil airports PAR: has trained personnel and Airport calculation in Asunción airport. VEN: exercise requested was made, personnel from Venezuela has participated in ATFM training workshops. BOL: training was provided to personnel in Viru Viru. URU: Continues with personnel problems. Support will be requested to the Regional Office to carry out activities.</p>
<p>Conclusion SAM/IG/4-1 SAM routes network point of contact</p> <p>That SAM States designate a point of contact to support the development of task 2.2.5 of the Action Plan for optimisation of the SAM Routes Network, and send the corresponding data (email and telephone) until 31 January 2010.</p>	YES	YES	YES	YES	YES	--	--	--	--	YES	YES	--	YES	YES	<p>BOL: César Varela URU: Gustavo Turcatti Tel.5982 604 0408 Int 5111 blantur@gmail.com VEN: Carlos Gonzalez and Pablo Rattia</p>

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
be posted on the website of the SAM Office, in order that each State, through a code, can have access to information on its fleet , and thus can perform the update of the data entered , and send it, via e-mail, to the Regional Office.															
Conclusion SAM/IG/4-5- Guidance for the application of a common methodology for calculating airport and ATC sector capacity The Guidance for the application of a common methodology for calculating airport and ATC sector capacity, shown in Appendix C to this part of the report, which recommends that SAM States apply the Brazilian methodology for calculating airport and ATC sector capacity, is approved.	YES	YES	YES	YES	YES	NO	--	--	--	YES	YES	--	YES	YES	BOL: adopted Brazilian method. VEN: there is no sufficient personnel yet to comply this task in 100%, currently working on data collection.
Conclusion SAM/IG/5-1 Training programme and documentation for air traffic controllers and AIS operators That SAM States use the material shown in Appendix A to this part of the report as guidance material for air traffic controllers and AIS operators.	O/G	YES	YES	YES	YES	--	--	O/G	--	YES	NO	--	YES	YES	BOL: PBN and ATC recurrent seminars were held. COL: Training for controllers and flight plan personnel has already started. There will be a transition period, since this amendment is effective as of April 2012. URU: PBN training was initiated. VEN: final training phase at the IUAC.

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
Conclusion SAMIG/5-2 PBN/RNAV5 seminars for operators That SAM States, in view of the few operators that have requested the approval, and the need to encourage them to start this process, conduct PBN seminars in which operators are informed about the corresponding approval procedures.	OG	YES	YES	YES	YES	OG	OG	OG	OG	YES	YES	OG	YES	YES	BOL: PBN seminars were carried out at all levels. COL: Several seminars were conducted for operators and several commercial operators have already started the process. It is suggested that the restrictions to be applied to uncertified operators as of 22 Sep 2011, be published. VEN: continuously.
Conclusion SAMIG/5-3 Data Collection That: a) SAM States collect data on flights conducted on domestic and international routes in the upper airspace (FL 245 or above) of the SAM Region during the period 1 to 15 July 2010, and send them to the SAM Regional Office before 13 August 2010; and b) That the sample be consistent with the form and the guidelines for completing the form described in Appendix B to this part of the Report, using the Excel format.	YES	YES	YES	YES	NO	--	--	O/G	--	YES	YES	--	YES	YES	VEN: sent to the regional office and delivered during SAM/IG/6 Meeting.
Conclusion SAM/IG/5-4 Implementation of Continuous Descent Operations That, recognizing the efficiency and environmental benefits of Continuous Descent operations, and the need to harmonize these operations in the interest of safety, States are encouraged to include the implementation of Continuous Descent operations (CDO) as part of their PBN implementation plans and to implement CDO in accordance with the ICAO CDO Manual.	O/G	O/G	O/G	YES	O/G	--	--	O/G	--	YES	NO	--	NO	NO	URU: will request support of Regional Office to restructure airspace and procedures construction.
Conclusion SAMIG/5-7 ATFM Teleconferences in the SAM Region That SAM States continue to hold	YES	YES	YES	YES	YES	NO	NO	NO	YES	YES	YES	NO	NO	YES	Web REDDIG II includes a speech communications sub-network to meet initial ATFM

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
weekly ATFM teleconferences between flow management units or flow management positions (FMU / FMP) to improve the exchange of information among participating States.															requirements.
Conclusion SAM/IG/6-1 Application of further actions to reduce the risk and risk rate resulting from the SAM ATS routes network optimisation safety plan That States, ATS providers and aircraft operators, take the necessary measures to apply recommendations and further actions in order to reduce the risk and resulting risk rate as shown in Appendix 1 to Chapter 4 of the Safety Plan for the SAM Region ATS routes network, as shown in Appendix A to this part of the report.	NO	O/G	YES	O/G	O/G	--	--	--	--	O/G	NO	--	YES	YES	
Conclusion SAM/IG/6-2 Application of subsequent actions to reduce the RNAV5 safety plan risk and the resulting risk rate That States, ATS providers and aircraft users take the necessary measures to apply further action to reduce the RNAV5 safety plan risk and the resulting risk rate, as shown in Appendix 1 to Chapter 4 of the safety plan for RNAV5 implementation in the SAM Region, shown in Appendix I to this part of the report.	NO	O/G	YES	O/G	O/G	--	--	--	--	O/G	NO	--	YES	YES	
Conclusion SAM/IG/6-3 Forms CMA F5 and CMS F6 That SAM States take pertinent action in order to apply forms CMA F5 and CMA F6, attached as Appendices A and B to this part of the report, and send them to CAR SAMMA as soon as the PBN approval of aircraft and operators is established.	YES	O/G	YES	YES	YES	--	--	--	--	O/G	NO	--	YES	YES	BOL: Approvals completed

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
Conclusion SAM/IG/6-4 ENR 3.3 – Table model of the AIPs That SAM States, in publishing in their AIPs RNAV routes, use the ENR table model shown in Appendix D to this part of the report.	YES	YES	YES	YES	YES	--	--	--	--	YES	YES	--	YES	YES	CHI: As defined in SAM/IG/7
Conclusion SAM/IG/6-5 Lateral navigation deviation reporting form That SAM States take the corresponding action in order to use the monitoring programme and particularly lateral navigation deviation reporting form attached as Appendix F to this part of the report, and send it to CARSAMMA on the tenth day of each month.	NO	--	YES	YES	YES	--	--	--	--	YES	YES	--	YES	YES	
Conclusion SAM/IG/6-6 Publication of an AIC/NOTAM announcing the postponement of the RNAV5 implementation date in the SAM Region That SAM States take the corresponding action in order to publish an AIC/NOTAM announcing the postponement of the RNAV5 implementation date in the SAM Region for 22 September 2011.	YES	YES	YES	YES	YES	--	--	--	--	YES	YES	--	YES	YES	CHI: NOTAM
Conclusion SAM/IG/6-7 Manual on Collaborative Decision-Making (CDM) for ATFM That SAM States adopt the Manual on Collaborative Decision-Making (CDM) for ATFM shown in Appendix B to this part of the report.	--	YES	YES	YES	YES	--	--	--	--	YES	NO	--	O/G	YES	BOL: the Manual of the FAA was adopted.
Conclusion SAM/IG/6-8 ATFM AIP SUPP/AIC MODEL That the States of the ICAO South American Region, when preparing their national AIC, use as a reference the ATFM AIP SUPP/AIC model shown in Appendix E to this part of the report.	--	YES	N/A	YES	NO	--	--	--	--	YES	YES	--	YES	YES	URU: depends on the delivery date by the provider (INDRA).

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
<p>Conclusion SAM/IG/6-9- Actions required for AMHS interconnection</p> <p>That SAM States, in view of the delays in the interconnection of the AMHS, proceed with the following actions:</p> <p>a) Require from their AMHS providers the necessary support to successfully end the necessary interconnections;</p> <p>b) Make necessary arrangements to train personnel in the interconnection tasks, with the aim of minimizing the dependency with their providers;</p> <p>c) Maximize pertinent coordination; and</p> <p>d) States that have not yet done so, complete the drafting and signature of the MoU.</p>	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<p>Actions corresponding to parts a), b) and c) of this Conclusion have been completed, pending only part d). French Guiana (France) and Uruguay have no AMHS.</p> <p>Uruguay has purchased an AMHS and expects to have the system operational by the end of the first quarter of 2014.</p>
<p>Conclusion SAM/IG/6-11 Changes in the AMHS systems and in the FDP for the implementation of Amendment 1 to the PANS/ATM</p> <p>That SAM States take into account the contents of Appendix D to this Agenda Item, with the aim that by 1 July 2012 they operate with the NEW flight plan format, in addition to the CURRENT format, States that have identified problems in their AMHS must make the corresponding changes before 31 December 2011. Also, the changes to make in the FDP installed at the various ATS units should be effected by the end of March 2012.</p>	YES	O/G	O/G	O/G	O/G	O/G	O/G	YES	O/G	O/G	YES	YES	O/G	O/G	

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
Conclusion SAM/IG/7-1 ATS routes network optimisation programme of the South American Region, Phase 3, Version 02 That ICAO SAM States take pertinent actions to follow the guidelines and comply with established deadlines to continue with Phase 3, Version 02 of the ATS routes network optimisation programme of the South American Region, shown in Appendix A to this part of the report.	--	YES	--	YES	O/G	--	--	--	--	O/G	--	--	NO	--	
Conclusion SAM/IG/7-2 Implementation of RNAV-5 That SAM States implement RNAV-5 in continental airspace routes, on 20 October 2011, at 09:01 UTC.	YES	YES	--	YES	YES	--	--	--	--	YES	--	--	YES	YES	
Conclusion SAM/IG/7-3 Documentation to be published for the implementation of RNAV-5 That SAM States publish the following documentation no later than 22 September 2011, effective on 20 October 2011: a) Amendment to the AIP or AIP Supplement containing the applicable standards and procedures, including the corresponding in-flight contingencies, the model of which appears in Appendix C to this part of the report; and b) The ENR 3.3 Tables that correspond to RNAV routes, using the model shown in Appendix D to this part of the report. Note: Appendix E contains 4 examples that may be used as a reference by the States.	YES	YES	--	YES	YES	--	--	--	--	YES	--	--	YES	--	

APPENDIX C**TOPICS TO BE TAKEN UNDER CONSIDERATION AT THE NEXT MEETINGS OF THE SAM IMPLEMENTATION GROUP**

1. Transition from a ground based air traffic management to an aircraft performance based navigation (PBN) system:

- a) Optimization of the SAM airspace;
- b) PBN implementation in the SAM Region; and
- c) Standards and procedures for the approval of PBN operations

ASBU Block 0 modules covered by this activity:

- B0-65 or B0-APTA
- B0-05 or B0-CDO
- B0-20 or B0-CCO
- B0-10 or B0-FRTO

2. Air Traffic Flow Management (ATFM) implementation in the SAM Region and improved airport operations through collaborative decision-making (CDM)

ASBU Block 0 modules covered by this activity:

- B0-35 or B0-NOPS
- B0-80 or B0-ACDM
- B0-15 or B0-RSEQ

3. Assessment of operational requirements in order to determine the implementation of communications, navigation, and surveillance (CNS) capabilities improvement for en-route and terminal area operations

ASBU Block 0 modules covered by this activity:

- B0-25 or B0- FICE
- B0-84 or B0-ASUR
- B0-40 or B0-TBO
- B0-75 or B0- SURF
- B0-101 or B0-ACAS

4. Operational implementation of new ATM automated systems and integration of the existing systems

ASBU Block 0 modules covered by this activity:

- B0-102 or B0-SNET
- B0-25 or B0- FICE (shared with Activity 3)
- B0-15 or B0-RESEQ (shared with Activity 2)

5. Improvement of air navigation services through digital aeronautical information and meteorological information management in support of performance improvement and safety, through:

- a) Digital aeronautical information management; and
- b) Meteorological information management.

ASBU Block 0 modules covered by this activity:

- B0-30 or B0-DATM
- B0 105 or B0-MET

Agenda Item 2: Optimization of the SAM airspace

- a) **En-route PBN**
- b) **PBN in terminal areas**
- c) **PBN procedure**

GREPECAS Project A1

2.1 The Secretariat informed the Meeting that at the second meeting of the GREPECAS Programmes and Projects Review Committee (PPRC/2), held at the South American Regional Office (SAM) on 16-18 July 2013, it was felt that the name of the PBN Programme should be maintained, but the proposal of including the airspace optimisation programme in the PBN Programme was accepted, thus extending the scope of Project A1.

2.2 Regarding GREPECAS Project A1, the Secretariat planned a series of deliverables in order to extend the scope of the Project, in accordance with the requirements of SAM/IG/11, to support PBN design of terminal areas by the States, and approval by the PPRC/2 meeting. The proposed deliverables are as follows:

- Prepare and conduct a course/workshop on terminal area design applying PBN.
- Prepare and designate a support team (ST) to assist States that need direct assistance in the implementation of airspace optimisation.
- Develop a planning strategy for terminal area optimisation.
- Develop guides for the design, assessment, and selection of the navigation specification to be applied in TMAs, as applicable.
- Develop procedures for verification and validation of the concept and procedures using risk analysis.
- Identify restrictions for the implementation and development of pre-implementation training guides.
- Action plan for Version 03 of the SAM ATS Route Optimisation Programme.
- Design the tasks required for the implementation of Version 03 of the SAM ATS Route Optimisation Programme.
- Regional strategy and work programme for the implementation of the flexible use of airspace applying a phased approach, starting with a more dynamic sharing of reserved airspace.

2.3 The Meeting noted that as a second step, it is necessary to identify the parties responsible for the deliverables and the dates of implementation in the Project Description (**Appendix A1**) and in the GANTT template (**Appendix A2**).

2.4 The Meeting concluded that it would be necessary to make a more comprehensive assessment of the project, in order to include the implementation phases of RNP 2 (Continental airspace) and RNP 4 (Oceanic airspace).

Basic PANS-OPS course for the SAM Region

2.5 The Meeting was informed that during the SAM/IG/11 meeting, it was recognised that one of the main problems being faced by some Administrations in the Region is undoubtedly the natural turnover of aeronautical experts, which poses new challenges in terms of training new personnel.

2.6 In this regard, the SAM/IG/11 meeting noted that, in most States, experts lacked training to face PBN implementation with regard to basic procedure design, PBN procedure design, and terminal area design.

2.7 In this respect, the Technical Cooperation section of the Regional Office got in contact with the Administration of Ecuador, which had offered to cover part of the costs of the PANS-OPS course in that country. Ecuador informed that they were making the corresponding internal arrangements. Accordingly, the Office is waiting for the formal request for the acquisition of the course within the aforementioned framework.

PBN procedure design courses

2.8 The Meeting recognized that the States of the Region should also analyse current and future training requirements of their experts in PBN procedure design, and plan the corresponding courses.

2.9 While discussing GREPECAS A1 Project, the Meeting deemed it convenient to review the Action Plan for the Optimization of the South American airspace, in order to harmonize it with A1 Project and insert the new tasks discussed and adopted during the meeting. The revised Action Plan is included as **Appendix B** to this part of the Report.

ATS route optimisation programme in the South American Region

2.10 The Meeting was informed on the developments being made in the Region with the route optimisation adopted in the ATS/RO/5 meeting, by implementing the Route Optimisation Programme based on the plans developed by SAM/IG meetings, applying a more ample concept covering the whole airspace.

2.11 Route UM662, which was pending since the beginning of the programme, was finally implemented with a view to optimising the Guayaquil-Madrid route.

2.12 It was noted that based on the 160 monthly operations carried out along that route (60 B767 operations, 60 A340 operations, and 40 B777 operations), the IFSET tool has calculated an initial annual savings of **730.800 kilograms of fuel** and an annual reduction of **2.307 tonnes of CO₂** from the date of its implementation on 17 October 2013.

2.13 It was also informed that during the 2001-2012 period, CO₂ emissions into the atmosphere were reduced by approximately 134,460 tonnes per year. This is a conservative estimate that does not take into account the reduction in CO₂ emissions resulting from RVSM implementation in the SAM Region in 2005.

2.14 The Meeting noted that at the ATS/RO/5 meeting held in Lima on 1-5 July 2013, the States analysed and updated the set of routes proposed for the optimisation of ATS route network in the SAM Region, Phase 3, Version 02.

2.15 When planning this implementation, it was felt advisable to divide route implementation into two stages, as shown in the report of the ATSRO/5 meeting, taking into account that some States were also significantly redesigning their terminal areas. The remaining routes of Version 02 are open to new adjustments while the first stage is being implemented.

2.16 Regarding the first implementation stage, it was felt advisable to set two different dates for two different groups of routes. For the first date, 2 new RNAV routes were selected, and 11 routes were realigned, several segments of which were eliminated to make the routes more direct and save a total of 123 NM in 1,151 monthly operations, mainly B737, A320, and B767 aircraft.

2.17 This first stage of Phase 3, Version 02 of the SAM route optimisation will be implemented on 12 December 2013. Using the IFSET tool, it was estimated that **11.760.000 kg** of fuel would be saved and **37.161 tonnes of CO₂** reduced per year, starting on the implementation date. The second date of the first stage was set for June 2014.

2.18 In summary, with the early implementation of route UM662, in addition to the implementation of the first stage of Phase 3, Version 02 of the ATSRO programme, **an annual reduction of 39.468 tonnes of CO₂** is achieved.

Selected period	Reduction of CO ₂ emissions, in tonnes
2001 to 2012	134,460
2013 to 2014	39.468

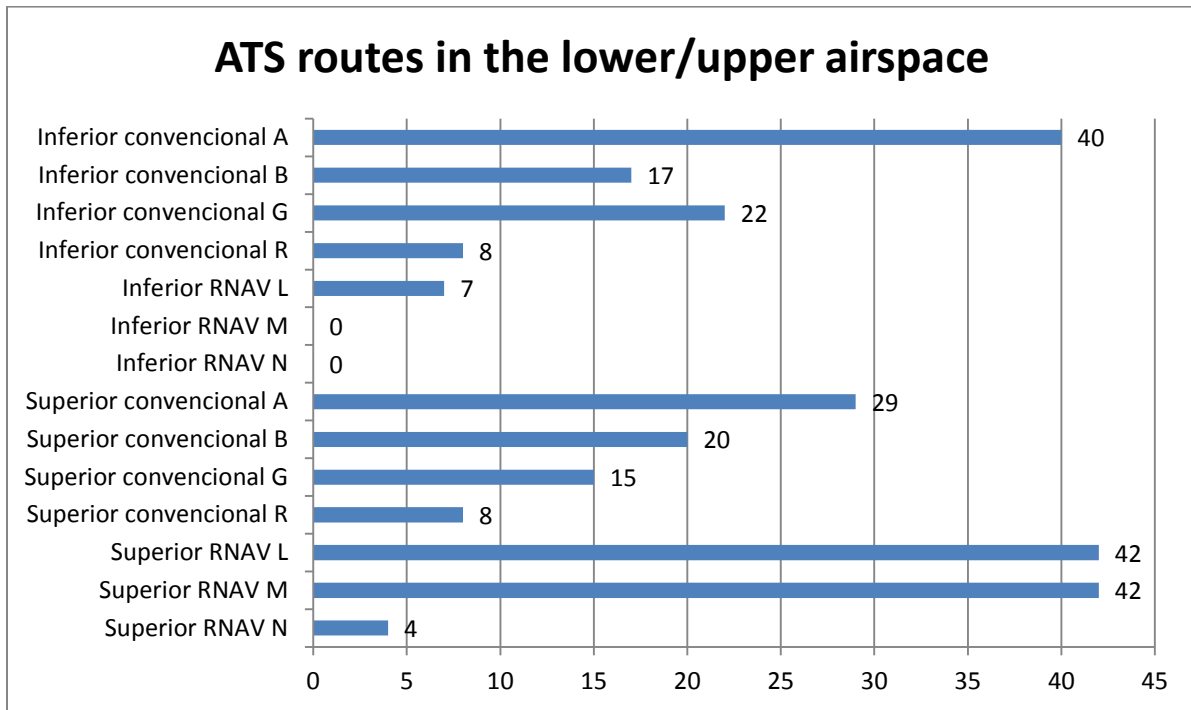
2.19 The following table shows the optimisations made to date under the ATSRO Programme.

Route optimisation in the South American Region			
Phase/Version	Status	Date	Optimisation
Phase 1 - RNAV-5	Implemented	October 2011	77 new RNAV routes 58 routes optimised 7 routes eliminated
Phase 2 - Version 01	Implemented	March 2011	15 new routes 19 routes optimised 18 routes eliminated
Phase 3 - Version 02	Stage 1	October 2013	1 RNAV route - UM 662
		December 2013	2 new routes 11 routes optimised 4 segments eliminated
		June 2014	6 routes optimised
	Stage 2	November 2014	12 candidate routes under study

2.20 The meeting noted that the study conducted by the consultant on regional efficiency indicators for the SAM ATS route network revealed that a total of 254 regional ATS routes have been published, 94 in the lower airspace (37%) and 160 in the upper airspace (73%).

2.21 Regarding the **94 ATS routes** of the lower airspace, 87 correspond to conventional routes (routes A, B, G, and R), accounting for 92%, and 7 to PBN routes (routes L, M, and N), accounting for 8% of the total. Regarding the 160 ATS routes in the upper airspace, 72 (45%) correspond to conventional routes (routes A, B, G, and R) and 88 (55%) to PBN routes (routes L, M, and N).

2.22 The graph below shows the number of conventional ATS and PBN routes in the lower and upper airspace of the SAM Region:



2.23 In summary, out of the 254 routes that make up the regional ATS route network, 159 (62%) correspond to conventional routes, and 95 (38%) to PBN routes.

Total number of ATS routes	PBN routes	ICAO indicator: % PBN routes
254	95	38%

2.24 The Meeting analysed the convenience that States of the Region study the possibility and carry out feasibility studies for the implementation of an exclusionary airspace for RNAV-5, should this be from FL 245 or from FL 290.

2.25 With regard to the aforementioned, the Meeting considered the possibility to present an information paper to the RAAC/13 meeting, in order to include, if deemed appropriate, this option as a commitment in the Bogota Declaration.

2.26 Regarding two-way RNAV-10 routes with a separation of 50 NM over the Pacific, the Meeting understood to study the possibility of implementation of RNP-4 navigation with a separation of 30 NM and/or assigning one single direction to both routes for the sake of safety. To carry out this implementation, it would be necessary to develop a specific project for this purpose.

Elimination of route UL474 in the next amendment to the South American route network

2.27 The Meeting noted that Colombia proposed the elimination of route UL474 in the Barranquilla FIR for safety reasons, since it converges with several routes at the same level. Furthermore, there are coordination issues with the adjacent Kingston FIR, resulting in the entry of traffic without prior coordination, existing as well communication problems in that area.

2.28 On this regard, the Secretariat queried the delegate of Panama, who mentioned there is no objection to support such elimination and informed Colombia that the elimination of route UL474 would remain subject to coordination with CAR Region.

PBN in terminal areas at international airports of the SAM Region

2.29 The Meeting recalled that the SAM/IG/11 meeting concluded that it would be advisable to complete the training of experts of SAM States, bearing in mind that not all the States participating in the Project could attend this course/workshop. Furthermore, the meeting considered that it would be essential to continue this process to assist States in the redesign of their TMAs applying PBN.

2.30 In the South American Region, the States that could not participate in the first course/workshop on PBN design of terminal areas were: **Bolivia, Chile, Ecuador, Guyana, Panama, Suriname, Uruguay, and Venezuela.**

Courses on PBN terminal area design in the SAM Region

2.31 Pursuant to Conclusion SAM/IG/11-1 (*Support to SAM States in the redesign of their TMAs*), which deemed it advisable to extend training in the Region to facilitate this implementation, there is a need to plan the activities under Project RLA/06/901 for 2014, and in this regard, determine how many TMA design courses/workshops are necessary before submitting them to the approval of the next meeting of the Project Coordination Committee.

2.32 The Meeting had an extensive and fruitful debate and analysed various modalities to conduct this training on PBN terminal area design, seeking practical and financial optimisation. In this sense, the following planning principles were agreed upon:

- **Modality:** Conduct training in three consecutive phases:

The first phase consists of on-line PBN training through the ICAO website, and a study of the following PBN-related manuals: *PBN Manual* (Doc 9613), *Manual on the use of PBN in airspace design* (Doc 9992), *Continuous descent operations manual* (Doc 9931) and *Continuous climb operations manual* (Doc 9993). There are some manuals that have been published only in English.

The second phase of training consists of participation for 2 weeks in Workshop I on PBN Airspace Design, with an intensive schedule from 08:30 to 16:30 and the appropriate breaks. The workshop would be held at the ICAO Regional Office in Lima. The objective is to provide theoretical/practical training on PBN terminal area design, selecting 1 complex TMA and 1 simple TMA for the practical exercise.

The third phase of training consists of Workshop II on PBN Airspace Design, for one week, where the participants of the First Workshop present the basic preliminary design for 1 TMA selected for each State, so that it may be corrected and improved during the workshop using the techniques of the First Workshop.

- **Participants:** The meeting agreed that, in order to achieve the proposed objective, the participants of the two workshops should be the same, since they are part of a phased training.

Profile of participants: In this regard, it was felt that States should send at least one expert on airspace planning, with experience in terminal area and/or route design, and one expert in instrument procedure design, with experience in the use of Auto-Cad software or other computer design tools, to attend the workshop. In order to optimise training, it is deemed advisable for the participating experts to have plans to remain in the Administration for at least 5 years after training is completed, in order to ensure the transfer of knowledge to other experts and to be able to work directly on the design and implementation of the selected terminal area and to submit the basic preliminary design to the Second Workshop for correction and improvement.

Other participants: It was felt that procedure designers and airline pilots/technicians/operation engineers would be of special assistance in both workshops for the assessment of procedures and to illustrate participants on the performance of different types of aircraft. In this sense, it was decided that airlines would be invited to establish design groups with the appropriate expert mix.

- **Funding:** It was deemed necessary to request the support of Project RLA/06/901 for the provision of **2 fellowships** for each State participating in the Project, for the two workshops being planned.

NOTE: The Meeting accepted and acknowledged the kind offer made by LAN Group and AVIANCA, which, in view of the importance of these events, offered their support to transport the experts to Lima to attend the workshops.

- **Terminal areas selected for Workshop I:** Bogota TMA and Asuncion TMA.
- **Likely dates, to be confirmed by the Secretariat:**

First Workshop on PBN airspace design: 28 April to 9 May 2014.

Second Workshop on PBN airspace design: 30 June to 4 July 2014.

- **Information to be provided by the experts designated by the States:** In order to conduct the workshops, data must be collected on traffic (identification of main traffic flows), AIP information on the selected TMA, aeronautical charts, current arrival and departure procedures, current instrument procedures, performance of user aircraft, etc.

- **Conditions for participation:** In order to attend the courses, the participants must meet all the established requirements, including having passed the on-line PBN courses, have the required technical qualifications, plans to stay in the Administration following completion of training for the foreseen period of time, and delivery of the data requested by the Secretariat for the practical exercises.

Airspace optimisation in Peru

2.33 The Meeting was pleased to note that, as a result of the Workshop on PBN Airspace Design held in March 2013 in Miami, and within the framework of the South American Airspace Optimisation Programme, the DGAC of Peru had started in June of this year an **Airspace reorganisation and performance-based navigation implementation programme - PROESA/PBN**, an initiative that is aligned with the pre-publication of ICAO Doc 9992 "*Manual on the use of PBN in airspace design*", which describes an agile methodology for the implementation of PBN airspace in 4 phases, subdivided into 17 activities.

2.34 Likewise, the Meeting took note that the significant increase in domestic and international operations (arrivals, departures, and overflights) in the Lima FIR over the last 5 years (in the order of 12%-15% per year) showed the need for airspace reorganisation, an analysis of ATS service capacity, and a more efficient sectorisation in the Lima ATC control centre and other units of the country.

2.35 Furthermore, the implementation of the new ATM automated system of CORPAC (8 radar sensors covering 94% of continental airspace and the new ACC) has led to a conceptual change in the Lima FIR airspace, including the main TMA control areas (Lima, Cusco, etc.).

Scope of PROESA

2.36 **PROESA** will serve as the basis for the new National Air Navigation Plan of Peru, which is already refocusing on the ICAO Aviation System Block Upgrades (ASBU) methodology.

2.37 The **PROESA** programme contemplates the participation of the ATM community and the national industry, as well as international organisations, professional associations, and users in general.

2.38 In the first stage of diagnosis and planning, the DGAC, CORPAC and aircraft operators represented by IATA and LAN PERU have been working together. The objective of this first stage is to restructure the Lima TMA, the Cusco TMA and the Lima-Cusco-Lima corridor, which is currently the busiest, and whose implementation is foreseen for the second quarter of 2014.

2.39 This reorganisation will be consistent and harmonised with the improvement initiatives underway in regional routes and will further the implementation of RNAV/RNP procedures at the aerodromes of the country, as well as continuous descent/climb operations (CDO/CCO).

2.40 Finally, **PROESA** will offer a new and more efficient route structure, with less climb/descent constraints, both en-route and in the TMAs, reducing pilot and controller workload, trying to reduce vectoring for RNAV paths, decongesting frequencies and giving more time to pilots and controllers for conducting their respective activities, increasing situational awareness by transferring navigation to optimum flight path database coding.

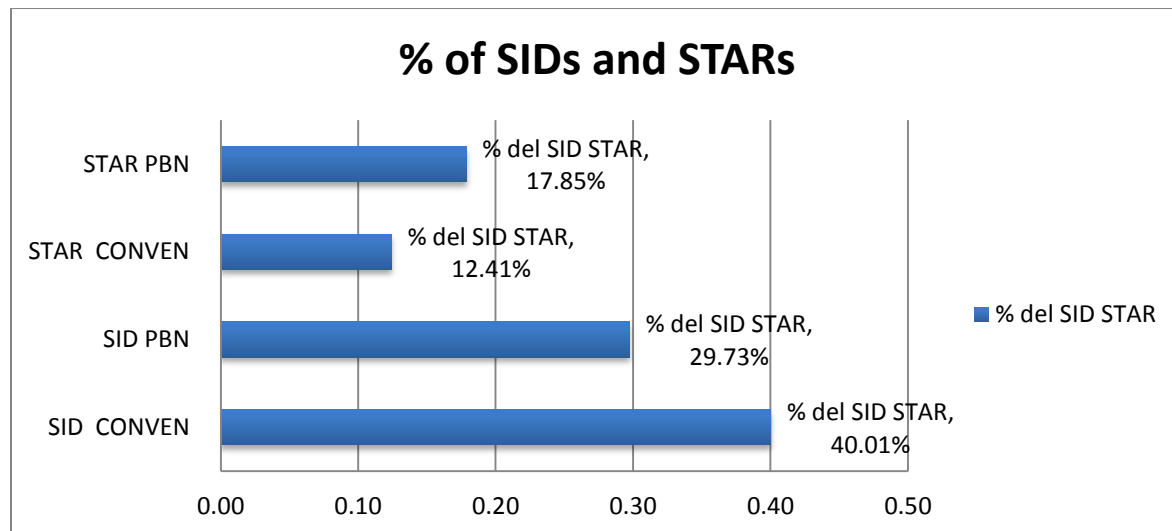
Standard arrivals and departures (STARs and SIDs)

2.41 The Meeting took note that the results of the study conducted by the consultant on standard arrivals and departures are as follows:

- a) Regarding standard arrival procedures (STARs), out of a total of **512 procedures**, 210 are conventional procedures (41%) and 302 are procedures developed under the PBN concept (59%);
- b) Regarding standard departure procedures (SIDs), out of **1,180 procedures**, **677** are conventional procedures (57%) and 503 are procedures developed under the PBN concept (43 %). The following breakdown identifies the number and percentage of SIDs and STARs in the Region:

Percentage of SIDs and STARs	Conventional SIDs	PBN SIDs	Conventional STARs	PBN STARs	Total 1680
Total	677	503	210	302	
% of SIDs and STARs	40.0	29.7	12.4	17.8	

2.42 The following figure illustrates the different categories of SIDs and STARs:



2.43 In summary, a total of 1,680 STAR and SID procedures have been designed and published for 99 international airports in the SAM Region, out of which 878 (52%) are conventional, and 802 (48%) are PBN concept.

Total number of airports	Total SIDs/STARs	Total PBN SIDs/STARs	ICAO Indicator % PBN SIDs/STARs
99	1680	805	48 %

Continuous descent and continuous climb operations

2.44 The Meeting was informed that PBN implementation in TMAs and their restructuring entail the use of continuous descent and continuous climb operations known as CDOs and CCOs, which are closely related to SIDs and STARs.

2.45 It was noted that although information has been obtained on the application of continuous descent and continuous climb techniques in the PBN STARs and SIDs of the SAM Region, and although there are many STARs that contain CDO elements, they have not been published as such and do not have an indication specifically alerting the pilot or the ATCO of such condition.

2.46 As an example and according to the information received, the 56 PBN STARs of SBBR (Brasilia) and the 24 PBN STARs of SBRF (Recife) had been developed applying CDO techniques. Likewise, by the end 2013 it is expected to implement STARs with CDO application in the arrivals of SBSP, SBGR, SBKP, SBSJ, SBGL and SBRJ.

2.47 Furthermore, the current ICAO documentation on publication of these procedures does not refer specifically to showing this condition or reflecting it somehow in the charts, notwithstanding that the CDO operations manual indicates that same should be published. The Secretariat considered that this publication gap may seriously affect the situational awareness of both pilots and controllers.

2.48 In this regard, the Meeting received for review information on some examples shown in **Appendix C** to this part of the Report, concerning the AICs of France and Singapore, which make reference to the CDO, and some CDO procedures at the Los Angeles airport where no specific reference is made to the CDO. It may be inferred that the same is probably true for continuous climb operations (CCO).

2.49 The Meeting considered this matter of utmost importance and instructed the Secretariat to contact the technical officers at Headquarters in order to obtain additional information regarding the proper or recommended procedure for such operations.

PBN instrument approach procedures

2.50 During the Meeting, under this item it was recalled that the SAM/IG/11 meeting recognised the importance of following up the status of implementation of ICAO Assembly Resolution A37-11, mainly with respect to the implementation of approach procedures with vertical guidance, which should reach 70% of thresholds with IFR operations in 2014.

2.51 Through letter LT2/3A.39-SA204, the Secretariat sent a survey to SAM States to be responded by 8 May 2013. The Regional Office, using funds from its Regular Programme, hired an expert to analyse the information, complete the missing information, and develop a dynamic template to be used as the baseline for the status of implementation of improvements in regional efficiency.

2.52 Information on standard approach, departure, and arrival procedures was obtained through a survey carried out on the second quarter of 2013. This survey provided information on all instrument approach procedures (IAP) for runways and international airports contained in the CAR/SAM Air Navigation Plan.

2.53 Not all SAM States responded to the survey. Consequently, the information contained in the AIPs available at the Regional Office in electronic or physical format was used as official source. Likewise, and despite having the response from the States, the information was verified with that officially published in the respective AIPs. In other cases, the information was reviewed based on publications of private aeronautical information providers.

2.54 The Meeting was widely informed that ICAO intends to post regional efficiency graphs on the public website of each of its Regional Offices, showing the regional status of implementation of the strategic objectives of the Organization for the 2014-2016 period, and showing the efficiency indicators foreseen for the region. The new system will start operating in Africa in August 2013 and, for the other Regions, in March 2014, and will be updated every six months.

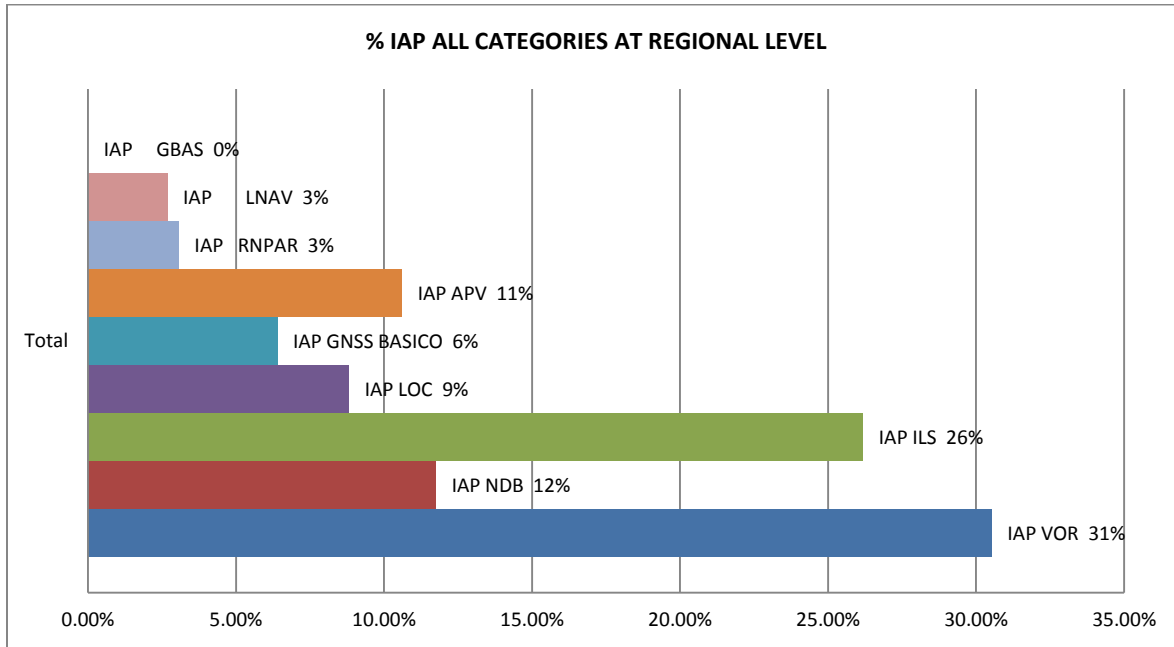
2.55 Regional efficiency data regarding existing instrument procedures, both conventional and PBN, in SAM States is shown in **Appendix D** to this part of the Report. The analysis comprised the following instrument approach procedures:

(IAP): VOR, NDB, ILS, LOC, APV, RNP AR, LNAV, basic GNSS, and GBAS.

2.56 The analysis conducted revealed that 783 conventional and/or PBN instrument approach procedures (IAP) have been designed and published for the 99 airports. The following breakdown identifies the number of procedures and the percentages based on all the procedure categories assessed:

IAP percentages	IAP VOR	IAP NDB	IAP ILS	IAP LOC	IAP GNSS BASICO	IAP APV	IAP RNP PAR	IAP LNAV	IAP GBAS
Totals	239	92	205	69	50	83	24	21	0
% of IAP	30.5	11.7	26.2	8.8	6.4	10.6	3.1	2.7	0

2.57 The figure below depicts all IAP categories at regional level:



2.58 Out of the total number of procedures, 77% (605) have been designed based on conventional radio aids (NDB, VOR, DME, LOC, ILS), while 23% (178) have been designed taking into account PBN. In this case, LNAV, RNP AR, APV procedures were considered, and basic GNSS was included. GBAS IAPs for international aerodromes have not been published yet in the SAM Region.

2.59 In the SAM Region, there are 783 approach procedures for the 99 airports, 178 are PBN approach procedures, including GNSS IAPs, out of which 107 are RNP APCH, accounting for 14%, distributed as follows: 83 APV baro-VNAV (APV) procedures (11%) and 24 RNP procedures with authorisation required (RNP AR), accounting for 3%, as reflected in the following table:

Total number of airports	Total IAPs	Total PBN IAPs	Total RNP APCH IAPs	% RNP APCH IAPs out of the total IAPs	OACI indicator: % of aerodromes with APV
99	783	178	83 APV baro-VNAV	11%	14%
			24 RNP AR	3%	

2.60 Furthermore, if we take into account Assembly Resolution A37-11, there are 114 runways in the SAM Region for which instrument procedures have been developed for 175 thresholds out of the existing 228. For those 175 thresholds, 107 APV procedures have been implemented, accounting for 61% of IFR runways.

Total number of runways	Total IFR runways	Total APV IAPs	ICAO indicator A37/11 % APV by IFR runways
114	175	107	61%

Regional efficiency indicators

2.61 The Meeting considered it important to note that regarding regional efficiency indicators for instrument approach procedures (IAPs), States must indicate their status of implementation, updating the information to the Secretariat.

2.62 The Meeting particularly noted the convenience of indicating the corresponding specification of navigation in such SIDs and STARs RNAV publications not having such indication at present.

2.63 The Meeting noted that all this information will be part of the regional efficiency indicators that the Regional Office will keep on its website, as coordinated with ICAO Headquarters.

2.64 Based on the aforesaid, the Meeting deemed it appropriate to approve the following conclusion:

Conclusion SAM/IG/12-2

PBN instrument approach procedures

That SAM States:

- a) publish the navigation specification corresponding to such SIDs and STARs RNAV not having such indication at present;
- b) complete the implementation of APV procedures for all instrument flight runway ends, whether as primary approach or as support to precision approach, with a view to completing 70% of PBN approaches by 2014 and 100% by 2016; and
- c) advise the Regional Office of any changes in the status of implementation of instrument approach procedures, whether conventional or PBN, annually, in order to update regional efficiency indicators.

Harmonization of transition altitude

2.65 The Meeting recalled that during the SAM/IG/11 meeting, recommendations of AN-Conf/12 applicable to the SAM/IG work programme were analysed, and on this regard, considered same were aligned with the activities contemplated in its programme, except for matters relating to regional harmonization of transition altitude (Rec 5/1, b), AN/Conf/12), which was included on that terms in the report.

2.66 The Meeting attended LAN Airline's concern, as SAM airspace user, on this matter.

2.67 In such sense, the Meeting was informed that Doc 8168 Vol I contemplated general guidelines for States on how to establish such Transition Altitude (TA) (see **Appendix E**, with the full text). Under these guidelines, two important sentences can be highlighted:

- That the TA above the aerodrome shall be as low as possible, but not less than 3000 Ft;
- That States, as far as possible, establish a common TA for all aerodromes of the State; or on the basis of previous agreement for aerodromes of adjacent States; or for aerodromes of one ICAO region (this TA shall be the highest that would be required if the aerodromes were considered separately).

2.68 The Meeting took note that in the Region there can be observed various TA published for the different airports and aerodromes of each country, corresponding to 3000 Ft above AD, 3000 Ft AMSL, to operational reasons or to the exaggerated elevation of a runway.

2.69 By checking the different AIP, as an example, the following can be observed:

<i>State</i>	<i>Published Transition Altitude</i>
Argentina	Different depending on the TMA
Brazil	Different depending on the TMA
Chile	Different depending on the TMA
Colombia	Fix at 18000 Ft
Ecuador	Different depending on the TMA
Paraguay	Fix at 3000 Ft
Peru	Different depending on the TMA
Uruguay	Fix at 3000 Ft
Venezuela	Different depending on the TMA

2.70 Several Organizations, among which IFALPA, IFATCA and EUROCONTROL stand out, have tried in recent times to promote the application of a uniform TA, higher than the 3000 Ft above the aerodrome recommended in Doc 8168. The reasons for this can be summarized as follows:

- **Reduce errors.** A uniform TA reduces the possibility of errors when changing the altimeter setting, since this action does not depend on where the aircraft is flying. This error mitigation measure becomes even more relevant when running PBN procedures with vertical guidance Baro VNAV, where a miss-setting in QNH or an omission in QNH could cause loss of separation with ground; so, the higher and further from the FAP this change occurs, the better.
- **High elevation aerodromes.** A uniform TA of more than 3000 Ft above AD allows better accommodating aerodromes of high elevation, which in the region are quite a lot, and some of them, having a large number of operations.
- **CDO performance.** By regulating QNH at least 30 Nm from destiny AD, FMS capacity to perform CDO improves, as the descent profile calculation done by the system is less affected by the difference between QNE and QNH. With a TA at only 3000 Ft above the aerodrome, only an average of the last 10 Nm are flown with QNH, which is not enough and complicates the operation in environments under very high or very low pressures.

- **Work load.** At higher altitudes, the crew has less workload than in the last segment of the approach, especially in those places where radar vectors should be followed to intercept the final approach. At this point, nothing should distract the crew's attention to permit their adequate following the instructions.
- **Sterile cockpit.** Under 10000 Ft the concept of sterile cockpit is applied. During this period, pilots should concentrate to the fullest avoiding talking or thinking about any other matters not related to the immediate operation and provision of all what has been discussed previously in the approach or takeoff briefing. To conduct the altimeter resetting outside of this period would be very helpful to increase flight safety.

2.71 Additionally, the Meeting noted that a finished and complete analysis to better understand the importance of this subject, can be found at:
<http://www.eurocontrol.int/sites/default/files/content/documents/nm/airspace/airspace-atmprocedures-flight-deck-perspective.pdf>.

Updating of Letters of Operational Agreement

2.72 The Meeting noted that as a result of the SAM/IG and ATSRO meetings, amendments have been introduced to the SAM ATS route network. Since 17 October 2013, route UM662 from Guayaquil to position DAREK has been implemented; 2 RNAV routes (UM411 and UM549) have been implemented, and routes UA317, UA321, UL201, UL216, UL304, UL550, UL795, UM417, UM530, UM548, and UM782 have been aligned, effective 12 December 2013. In such sense, following Letters of Operational Agreement were signed:

- Between Resistencia and Curitiba ACCs, for the change of route designator between POR VOR/FOZ VOR, now being UL216; and
- Between Amazonico and Maiquetia ACCs, for the realignment of routes UL417, UL314, UM423, UL795, UZ6 and UZ21.

2.73 Following Letters of Operational Agreement were signed by the representative of Brazil and submitted to States concerned for their later signing and transferring to the corresponding ACCs:

- Between Curitiba ACC/Asuncion ACC, for inclusion of route UL216;
- Between Amazonico ACC/Lima ACC for inclusion of route UM530; and
- Between Amazonico ACC/Bogota ACC for the reversal of direction of route UL201, realignment of route UM782 and for the change of designator of route UA317 to UM549.

2.74 The Letters of Operational Agreement between Curitiba, Amazonico and Cordoba ACCs with La Paz ACC and the cancellation of the Letter of Agreement between Brasilia ACC/La Paz ACC, could not be signed due to the absence in the meeting of the delegates from Bolivia.

2.75 Regarding the aforementioned, the Meeting regretted the absence of Bolivia, in view of the importance that the updating of Operational Letters of Agreement means for flight safety and in this sense, encouraged States to use all their available means to exchange reversal Letters and assure their signature as soon as possible.

Other matters related to flight safety and coordination procedures of Letters of Operational Agreement

2.76 The Meeting recalled that the CAR/SAM Regional Planning and Implementation Group (GREPECAS) delegated the implementation of the SMS methodology for the analysis of LHDs to the Caribbean and South American Monitoring Agency (CARSAMMA). CARSAMMA is an administrative agency under the *Departamento de Controle do Espaço Aéreo* (Airspace Control Department - DECEA), which is part of the Brazilian Airspace Control System (SISCEAB).

2.77 Likewise, the Meeting was informed that the Thirteenth Meeting of the Scrutiny Group (GTE/13), held in Lima on 9-13 September 2013, made a safety assessment of RVSM airspace in CAR/SAM FIRs. The meeting took note of the evolution of large height deviations (LHDs) in CAR/SAM FIRs, mainly in categories M and N.

2.78 At the GTE/13 meeting, CARSAMMA presented a summary of the evolution of safety in RVSM airspace in the CAR/SAM FIRs, which was based on a series of LHD reports covering a period of 3 years between 2010 and 2012.

2.79 Table 1 shows LHDs reported at the points of highest occurrence of risk in CAR and SAM FIRs for the 2010-2012 period.

Position	M	N
VESKA	113	42
VAKUD	33	26
PALAS	44	14
UGUPI	35	20
IREMI	46	8
OROSA	30	17
BEROX	52	5
PIGBI	32	17
POKAK	24	6
REPAM	22	4
SBAO-SUEO	54	25
PLG	21	8
SBAO-DIII	27	29
TERAS	20	8
AVELO	3	3

Table 1: LHD reports at the points of highest occurrence, in categories M and N

2.80 The GTE/13 meeting noted that M-coded LHDs (error in the ATC transfer message) were the most frequent during the 2010-2012 period, with 486 events, followed by Code N (lack of coordination), with 232 events.

2.81 It was also noted that Code M was the most frequent in almost all positions, except at the SBAO/SUEO and SBAO/DIII boundaries, where Code N prevailed due to the impact of traffic management between the Falkland Islands and the Ascension Island in the South Atlantic.

Safety analysis (SMS) of LHDs in the SAM Region

2.82 Table 2 lists LHD or operational errors that were considered by the GTE as having the highest risk (VR> 46) during the 12 months of 2012.

2.83 LHD 1158, which occurred in December 2012, accounted for 2.592% of the risk assessment for that month, with a VR = 60, the highest of the sample.

2.84 The Lima FIR appears 11 times with LHD reports for adjacent FIRs, since they contributed to the generation of risk in its RVSM airspace.

2.85 The Guayaquil FIR, in turn, appears 8 times in terms of risk generation.

Sequence	FIR subject to the risk	FIR generating the risk	GTE code	Risk value
7	ATLANTICO	MONTEVIDEO	N	46
59	ATLANTICO	ABIDJAN	N	46
150	ATLANTICO	MONTEVIDEO	N	46
408	ATLANTICO	MONTEVIDEO	N	46
592	ATLANTICO	DAKAR	N	46
657	ATLANTICO	MONTEVIDEO	N	46
839	ATLANTICO	ABIDJAN	N	46
884	ATLANTICO	MONTEVIDEO	N	46
1054	ATLANTICO	DAKAR	N	46
933	BOGOTA	GUAYAQUIL	N	46
1125	BOGOTA	AMAZONICA	N	51
1158	BOGOTA	GUAYAQUIL	N	60
3	LIMA	GUAYAQUIL	N	46
27	LIMA	GUAYAQUIL	N	55
64	LIMA	GUAYAQUIL	N	46
91	LIMA	LA PAZ	N	46
232	LIMA	LA PAZ	N	46
275	LIMA	AMAZONICA	N	46
281	LIMA	GUAYAQUIL	N	55
419	LIMA	AMAZONICA	N	46
534	LIMA	BOGOTA	N	46
694	LIMA	GUAYAQUIL	N	46
714	LIMA	GUAYAQUIL	N	55
188	MAIQUETIA	AMAZONICA	N	46

Table 2: LHDs with the highest risk value in 2012

2.86 The analysis includes a detailed review of certain operational errors in order to identify contributing factors and make sure that safety authorities of SAM FIRs implement procedures and processes to reduce the probability of recurrence of errors.

2.87 Likewise, there has been a significant increase in lack of transfer, resulting in serious loss of situational awareness of traffic, thus significantly affecting safety. N-coded LHDs are amongst the worst air traffic incidents, since the aircraft involved is not expected in a given position, at that level, or at the time of occurrence.

2.88 The high number of M- and N-coded LHDs shows the need for better coordination between adjacent air traffic control units, which could be achieved by sensitising and training controllers in coordination matters, and by better describing the procedures in the Letters of Operational Agreement.

2.89 The points of transfer identified in Table 1 for the SAM Region shall be taken into account both specifically and generally in the letters of agreement, which shall indicate the mitigation measure to prevent that type of errors that must have been already identified by States, thus ensuring better safety management.

2.90 Some FIRs have decided to automate transfer, with the cost that involves. However, there is still a coordination issue that is not reflected in the letters of operational agreement between adjacent FIRs, especially regarding the reception of flight plans, the duplication of flight plans, the lack of transfer specifications concerning aircraft attitude (climb/descent) or the delivery of a flight at the level at which traffic will be delivered.

2.91 Based on the aforementioned, the Meeting considered it of utmost importance to encourage States to conduct a more thorough review of the coordination procedures established in their Letters of Operational Agreement, in order to minimize the operational errors affecting safety as detailed above.

Airspace optimisation in Argentina

2.92 The Meeting noted that, as a result of the on-going airspace optimisation in Argentina, there was a proposal to eliminate UA558, the segment between: JUJUY VOR-CERES VOR-MULTA, and to eliminate UM784, the segment between: RESISTENCIA VOR-PILCO-BOLET (LA PAZ FIR). It is proposed that UL550 be unidirectional, in the segment between TUCUMÁN VOR and ROSARIO VOR. All these modifications would be effective in Phase 3 - Version 02 - Stage 1 - June 2014.

2.93 Likewise, the following has been considered: Proposal 54 (Santiago/Buenos Aires, unidirectional, realignment of UM424), Proposal 55 (Buenos Aires/Santiago, unidirectional, elimination of UA306 between EZEIZA-URINO TABÓN and the creation of a new RNAV between EZEIZA - ASADA TABÓN), as agreed at the SAM ATSRO/5; optimum implementation in Phase 3-Version 02-Stage 2: implementation date to be agreed upon. In this regard, the Secretariat would coordinate these modifications together with the implementation of the amendment corresponding to Stage 1, effective June 2014.

2.94 Regarding the above, the Secretariat would coordinate these modifications together with the implementation of the amendment corresponding to Stage 1, effective June 2014.

PBN matters at the SAM/IG/13 meeting

2.95 The Meeting considered that PBN training was a priority in order to proceed with implementation plans. In this sense, SAM States agreed not to include PBN matters in the agenda for the next SAM/IG/13 meeting and prioritise training in PBN airspace design.

Follow-up to the implementation of the RAIM availability prediction service on the web

2.96 The Meeting was informed by the Secretariat about the public tender for the implementation of the RAIM prediction service, and took note of the tender assessment process that had been carried out based on a pre-established protocol made available to participating companies. It was noted that three companies had submitted offers but only two had been assessed, since the third did not meet the requirements and was discarded by the ICAO Technical Cooperation Bureau.

2.97 The Meeting endorsed the process and requested additional information on service availability for RNP AR approaches. The Secretariat recalled that this availability was optional and was not included in the tender conditions.

APPENDIX A1

PBN OPERATIONAL IMPLEMENTATION PROJECT

<i>SAM Region</i>	PROJECT DESCRIPTION (DP)	DP N° A1	
<i>Programme</i>	Title of the Project	Start	End
<i>PBN</i> (Programme Coordinator: Roberto Arca Jaurena)	PBN Operational Implementation <i>Project coordinator: Alexandre Luiz Dutra Bastos (Brazil)</i>	2011	2018
Objective	Support the optimisation of the South American airspace structure through the optimisation of the ATS route structure in terminal (RNAV/RNP SID/STARs) and en-route (RNAV/RNP) airspace, as well as the implementation of PBN approaches pursuant to ICAO Assembly Resolution A37-11.		
Scope	The implementation project contemplates the optimisation of the South American airspace through the implementation of PBN and the application of the flexible use of airspace (FUA) concept, as well as the phased optimisation of the ATS route network of the Region.		
Metrics	<ul style="list-style-type: none"> • Reduction of CO₂ emissions in tonnes for each route optimisation version. • Percentage of RNAV and/or RNP SID/STARs implemented at international airports. • Percentage of continuous descent and climb operations implemented at international airports. • Number of RNAV/RNP routes implemented, realigned and/or eliminated. 		

Strategy	<p>The conduction of project activities will be coordinated among project members, the project coordinator, and the programme coordinator, mainly at SAM/IG meetings. The project coordinator will coordinate with the programme coordinator the inclusion of additional experts, if warranted by the tasks and works to be executed. Furthermore, the States must check their respective national RNAV route implementation programme for consistency with the SAM RNAV implementation programme. Activities involving the review, implementation, modification, or elimination of routes in the SAM Region are foreseen in order to continue with the optimisation of the ATS route structure.</p>
Goals	<p>Implementation of Version 02 of the ATS route network, based on RNAV, with the necessary PBN values to meet the current requirements of airspace users by the end of 2014. Strategy for the implementation of the FUA concept. Plan of action for route optimisation Version 03 by 2015. 30% of terminal areas optimised at the main international airports by 2016, 50% by 2018.</p>
Rationale	<p>The 36th ICAO General Assembly requested the Council to encourage Contracting States to improve air traffic efficiency resulting in emission savings, to report the progress made in this field, and to expedite the development and implementation of routings and procedures that will permit efficient fuel burn to reduce aviation emissions.</p>
Related projects	<ul style="list-style-type: none"> • Flexible use of airspace. • Automation. • Air navigation systems in support of PBN.

Project deliverables	Relationship with the performance-based regional plan	Responsible party	Status of Implementation*	Delivery date	Comments
Implementation of Version 01 of the ATS route network, based on RNAV, with the necessary PBN values to meet current requirements of airspace users.	PFF SAM ATM 01	Alexandre Luiz Dutra Bastos		October 2010	Completed
Implementation of RNAV5 in the SAM Region.	PFF SAM ATM 01	Alexandre Luiz Dutra Bastos		October 2011	Completed
Action plan for the implementation of Version 02 of ATS route network optimisation.	PFF SAM ATM 01	Alexandre Luiz Dutra Bastos		ATS/RO/3	Completed

Traffic data to understand airspace traffic flows.	PFF SAM ATM 01	ICAO coordinator		SAM/IG/6	Completed
Fleet navigation capacity.	PFF SAM ATM 01	Alexandre Luiz Dutra Bastos		SAM/IG/9	Completed
Listing of gateways of the main TMAs in the SAM Region.	PFF SAM ATM 02	Alexandre Luiz Dutra Bastos		SAM/IG/9	Few States have provided the data requested. The SAM/IG/11 meeting agreed to support States in the design of their TMAs so as to expedite PBN implementation.
Letters of Agreement and Contingency with adjacent States.	PFF SAM ATM 01	Alexandre Luiz Dutra Bastos		SAM/IG/10	Completed
Detailed study of the SAM ATS route network, route network Version 02	PFF SAM ATM 01	Alexandre Luiz Dutra Bastos		April 2012	Completed
Risk analysis for the implementation of Version 02 of the ATSRO Programme	PFF SAM ATM 01	External consultants		SAM/IG/10	Completed
“ <i>Airspace Modelling</i> ” studies and Fast-Time Simulation to assess the scenarios developed in the detailed study of the SAM ATS route network.	PFF SAM ATM 01	Alexandre Luiz Dutra Bastos		December 2014	This task is subject to the availability of Brazilian technical support and facilities in Jose dos Campos.

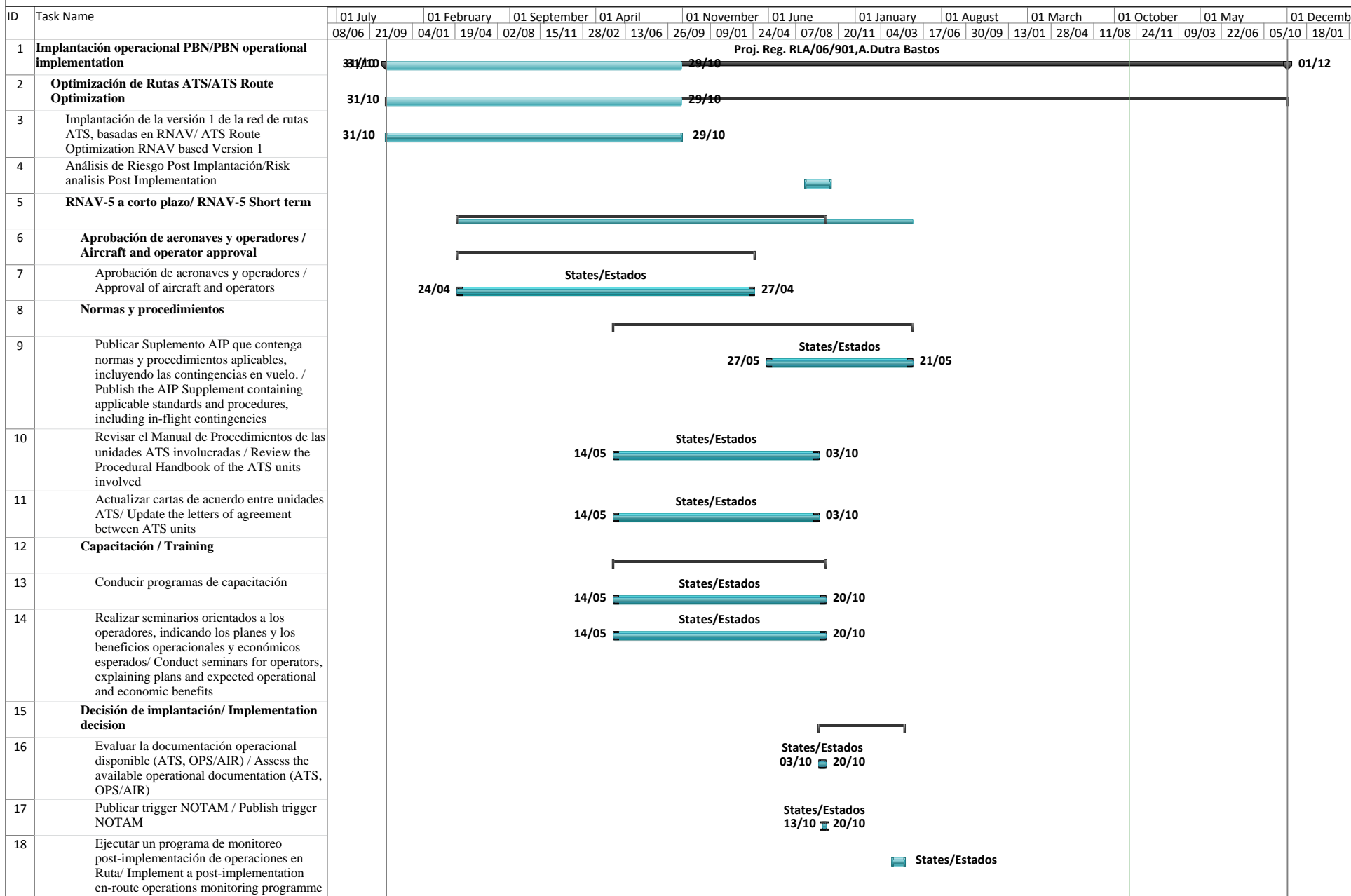
Prepare and conduct a course/ workshop on the design of terminal areas applying PBN		TBD		December 2013	New task to be approved
Develop the terminal area optimisation planning strategy		TBD		2014	New task to be approved
Develop guides for the design, assessment, and selection of the navigation specification to be applied in TMAs where required		TBD		2014-2016	New task to be approved
Develop concept verification and validation and risk analysis procedures		TBD		2014-2016	New task to be approved
Identify implementation restrictions and develop guides for pre-implementation training		TBD		2014-2016	New task to be approved
Plan of action for Version 03 of the SAM ATS route optimisation programme		TBD		October 2015	New task to be approved

Design the necessary tasks for the implementation of Version 03 of the SAM ATS route optimisation programme		TBD		2016-2018	New task to be approved
Regional strategy and work programme for the implementation of the flexible use of airspace, applying a phased approach, starting with a more dynamic sharing of reserved airspace		TBD		2013-2018	This task is currently under Project B2 of the SAM Region, and the proposal is that it be transferred to this Project.
Resources required	Designation of experts in the execution of some of the deliverables.				

*

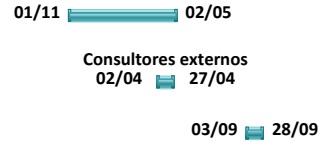
Grey Task not started
Green Activity underway as scheduled
Yellow Activity started with some delay but expected to be completed on time
Red It has not been possible to implement this activity as scheduled; mitigating measures are required

A1 - Implantación operacional PBN / PBN operational implementation



A1 - Implantación operacional PBN / PBN operational implementation

ID	Task Name	01 July		01 February		01 September		01 April		01 November		01 June		01 January		01 August		01 March		01 October		01 May		01 Decemb	
		08/06	21/09	04/01	19/04	02/08	15/11	28/02	13/06	26/09	09/01	24/04	07/08	20/11	04/03	17/06	30/09	13/01	28/04	11/08	24/11	09/03	22/06	05/10	18/01
19	Plan de acción Versión 02 optimización de la red de rutas ATS/ ATS Route Optimization Version 2																								
20	Datos de tráfico para entender los flujos de tráfico del espacio aéreo/Data traffic to understand traffic flows																								
21	Análisis de rutas ATS seleccionadas de la versión 2/Selected ATS Routes Vs.2																								
22	Análisis de riesgo para la implantación de la Versión 2 del Programa ATSRO																								
23	Simulación acelerada y Modelado de espacio aéreo/Fast simulation and airspace modeling																								
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APPENDIX B (revised 18/10/2013)**ACTION PLAN FOR THE OPTIMIZATION OF THE SOUTH AMERICAN AIRSPACE
(B0-5, B0-10, B0-20, B0-65)**

Activity	Start	End	Responsible party	Observations
1. Implementation of Version 2 of the SAM ATS Route Network / PBN implementation of main South American TMA				
Activity	Start	End	Responsible party	Observations
1.1 Airspace concept				
1.1.1 Collect traffic data to understand traffic flows.	SAM/IG/11	TBD	SAM/PBN/IG (Project RLA/06/901) States	The Secretariat sent a State letter: Response date: September 2011 Chile, Colombia, Paraguay and Uruguay sent traffic data on time. Another traffic data collection was conducted in August 2012. Bolivia, Chile, Colombia, Paraguay, Peru, Venezuela and Uruguay sent data. Data collected for CARSAMMA will be used for future works related to the action plan.
1.1.2 TMA				
1.1.3 Conduct a Seminar/Workshop/Work Meeting on airspace planning.	ATSRO/3	April 2013	Project RLA/06/901	Request the support of Project RLA/06/901. The purpose is to train airspace

				<p>planners of the States of the Region. This task was fulfilled with the conduction of a Course/Workshop on PBN design of CAR/SAM airspace and terminal areas on 11-22 March 2013, where IATA provided the instructors, CANSO the translation, and Project RLA/06/901 contributed with LAN Chile and LAN Peru designers to support the experts during the workshops. Argentina, Brazil, Colombia, Paraguay, and Peru participated from the SAM Region, together with two experts from Project RLA/06/901. A total of 8 experts from the SAM Region were trained. A practical exercise related to the Lima TMA was conducted.</p>	
1.1.4	Conduct the First Workshop on PBN airspace design in the SAM Region.	May 2014	May 2014	Project RLA/06/901 States	<p>Objective: complete the training of experts of the SAM Region, taking into consideration that not all States participating in the Project could attend the Course/Workshop held in Miami.</p> <p>2 weeks/2 fellowships by State. A practical exercise in Bogota and Asuncion TMAs</p>

				will be carried out.
1.1.5 Conduct the Second Workshop on PBN airspace design.	July 2014	July 2014	Project RLA/06/901	1 week. During this Workshop, States will present a preliminary PBN design on one of their State's TMAs, in order to be evaluated by the Workshop. Two fellowships per State will be requested for this Workshop.
1.1.5.1 Detail the planning of the optimization of the main SAM Region TMA, taking into account the base design developed by States, defining among other relevant aspects, the gateways of the main TMAs of the SAM Region.	SAM/IG/12	SAM/IG/14	States	
1.1.6 SAM routes network.				
1.1.6.1 Conduct a detailed study of the SAM ATS route network, with a view to preparing Version 03 of the route network, including: <ul style="list-style-type: none"> • Identification of the tools required for conducting the study mentioned (aeronautical charts, specific software). • Identification of ATS routes that should be 	SAM/IG/12	SAM/IG/14	SAM/PBN/IG (Project RLA/06/901)	Two experts will be hired for a period of 3 weeks on August 2014. Project RLA/06/901 will be requested to hire 2 experts for 3 weeks, to

<p>eliminated based on their utilization.</p> <ul style="list-style-type: none"> • Description of the interface between the SAM route network and the CAR route network. • Presentation of an initial proposal of amendment to the CAR/SAM ANP. • Development of planning criteria to be used by States and airspace users in this implementation process (see paragraph 2.13 of the ATSRO/03 report). 				initiate works for the development of Version 03 of the SAM route network, based on the preliminary PBN design of TMAs which were developed during the two workshops on PBN airspace design.
1.1.6.2 Conduct the Sixth Workshop/Meeting for the Optimization of the SAM ATS Route Network (SAM ATSRO/6), for the purpose of reviewing Version 03 of routes.	SAM/IG/10	September 2014	Project RLA/06/901 States	
1.1.7 Training				
1.1.7.1 Basic PANS/OPS Procedure Design Course.	May 2013	June 2014	RLA/06/901 Project SAM Regional Office States	Project RLA/06/901 will study the feasibility of responding to the request of Ecuador to conduct a basic PANS-OPS procedure design course in Quito, taking into account that Ecuador would cover 50% of the cost and provide 2 assistant instructors.
1.1.8 Safety assessment				
1.1.8.1 Prepare the required safety assessment, applying a qualitative methodology using the SMS.	31/07/12	SAM/IG/11	Project RLA/06/901 States	COMPLETED An expert needs to be hired for 2 weeks to carry out this task. (This task has been completed.)

1.1.8.2 Prepare the safety assessment required in their airspaces (route and TMA).		SAM/IG/12	States	States shall conduct a safety analysis of changes in their terminal areas (TMAs).
1.1.8.3 Conduct the third Workshop/Seminar/ Meeting on risk analysis of Version 02 of the SAM ATS route network.	September 2012	SAM/IG/11	RLA/06/901 Project States	COMPLETED

APPENDIX C

EXAMPLES OF PUBLICATIONS

(KEACH.KEACH1) 12264

KEACH ONE ARRIVAL (RNAV)

ST-237 (FAA)

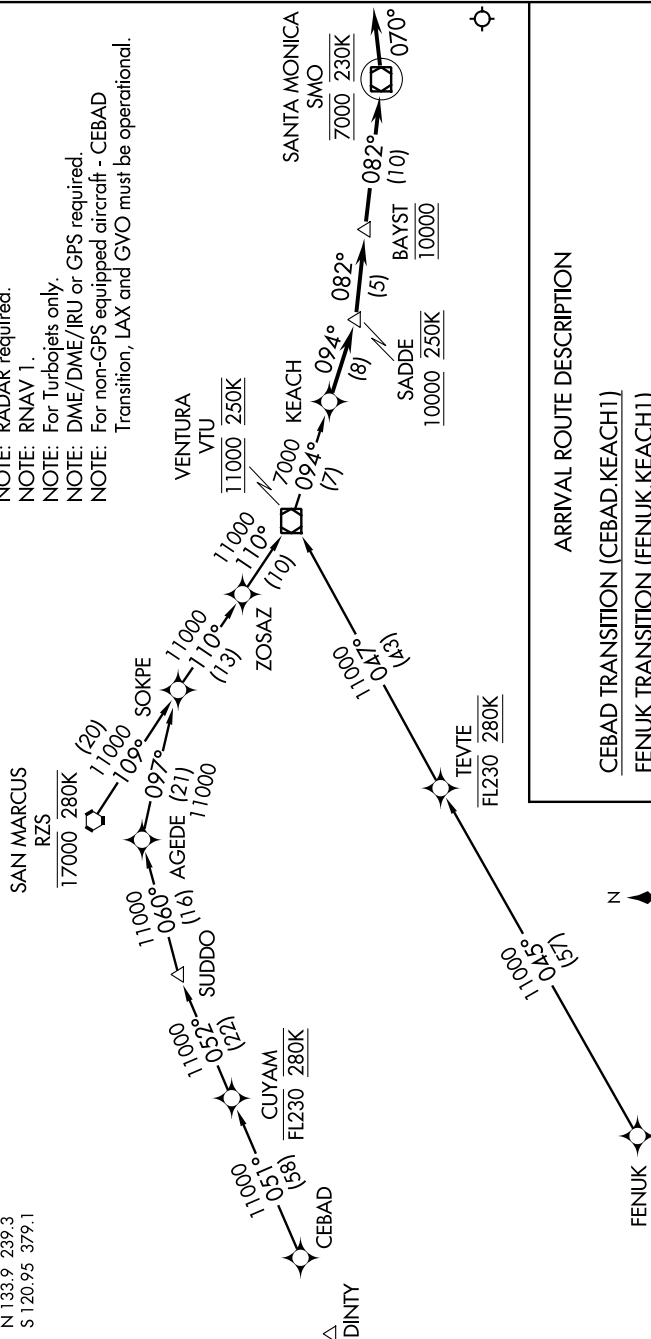
LOS ANGELES INTL (LAX)

LOS ANGELES, CALIFORNIA

SW-3, 04 APR 2013 to 02 MAY 2013

SOCAL APP CON
124.5 235.975
LOS ANGELES TOWER
N 133.9 239.3
S 120.95 379.1

NOTE: Rwy 25L/R or 24 L/R: Expect RADAR vectors to the final approach course.
NOTE: RADAR required.
NOTE: RNAV 1.
NOTE: For Turboprops only.
NOTE: DME/DME/IRU or GPS required.
NOTE: For non-GPS equipped aircraft - CEBAD Transition, LAX and GVO must be operational.



ARRIVAL ROUTE DESCRIPTION

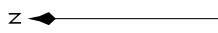
CEBAD TRANSITION (CEBAD.KEACH1)

FENUK TRANSITION (FENUK.KEACH1)

SAN MARCUS TRANSITION (RZS.KEACH1)

VENTURA TRANSITION (VTU.KEACH1)

From KEACH on track 094° to cross SADDE at or above 10000 at 250K, then on track 082° to cross BAYST at 10000, thence as depicted to cross SMO VOR/DME at 7000 at 230K, then on heading 070° for RADAR vectors.



△ ELKEY

NOTE: Chart not to scale.

KEACH ONE ARRIVAL (RNAV)

(KEACH.KEACH1) 12264

LOS ANGELES, CALIFORNIA

LOS ANGELES INTL (LAX)

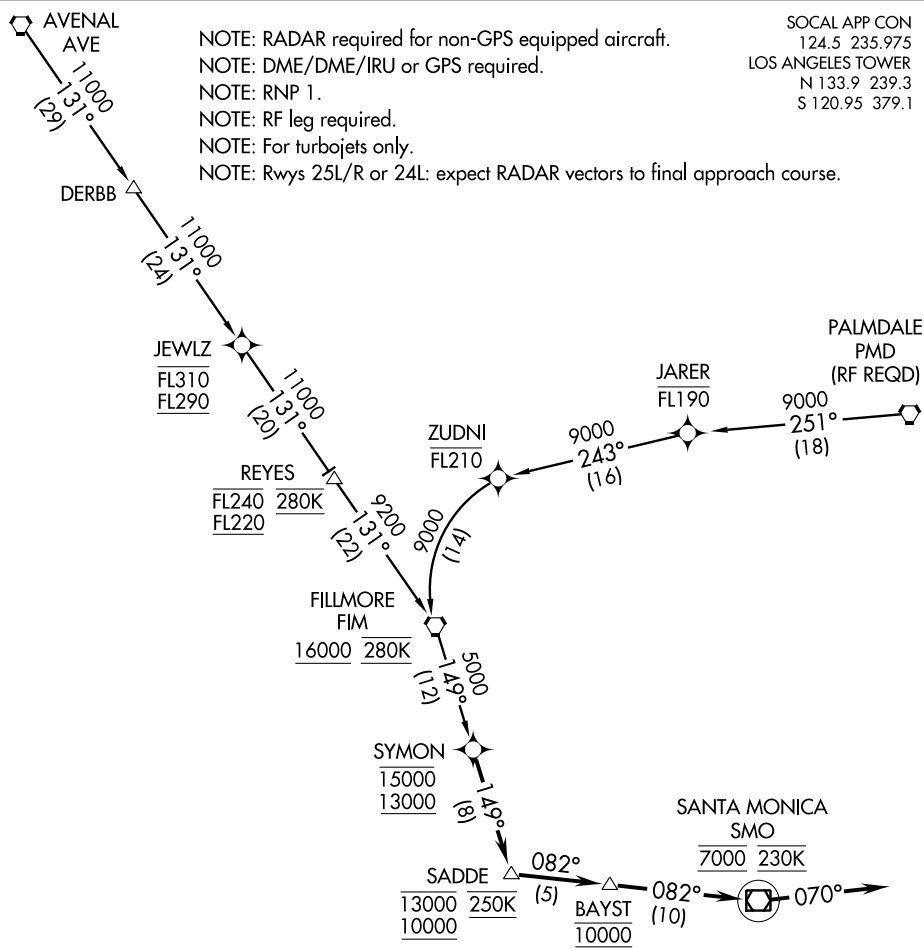
SW-3, 04 APR 2013 to 02 MAY 2013

(SYMON.SYMON1) 12264

SYMON ONE ARRIVAL (RNAV)

ST-237 (FAA)

LOS ANGELES INTL (LAX)
LOS ANGELES, CALIFORNIA



SW-3, 04 APR 2013 to 02 MAY 2013

SW-3, 04 APR 2013 to 02 MAY 2013

NOTE: Chart not to scale.

ARRIVAL ROUTE DESCRIPTION

- AVENAL TRANSITION (AVE.SYMON1)
- DERBB TRANSITION (DERBB.SYMON1)
- PALMDALE TRANSITION (PMD.SYMON1)

From SYMON on track 149° to cross SADDE at or above 10000 and at or below 13000 and at 250K, then on track 082° to cross BAYST at 10000, then on track 082° to cross SMO VOR/DME at 7000 at 230K then on 070° heading. Expect vectors to final approach course.

SYMON ONE ARRIVAL (RNAV)

(SYMON.SYMON1) 12264

LOS ANGELES, CALIFORNIA
LOS ANGELES INTL (LAX)

APÉNDICE D / APPENDIX D**ESTADO DE IMPLANTACIÓN DE LOS PROCEDIMIENTOS DE APROXIMACIÓN INSTRUMENTALES (IAP) CONVENCIONALES Y
PBN POR ESTADO EN LA REGIÓN SAM****IMPLEMENTATION STATUS OF CONVENTIONAL AND PBN INSTRUMENTAL APPROACH PROCEDURES (IAP) BY STATE IN THE REGION**

AEROPUERTOS INTERNACIONALES/ INTERNATIONAL AIRPORTS ANP CAR/SAM	IAP VOR	IAP NDB	IAP ILS	IAP LOC	IAP GNSS BASICO	IAP APV	IAP RNP PAR	IAP LNAV	IAP GBAS	SID CONVEN	SID PBN	CCO	STAR CONVEN	STAR PBN	CDO
ARGENTINA	42	18	53	53	10	0	0	0	0	54	29	0	39	40	0
BOLIVIA	8	4	7	0	2	0	0	0	0	48	0	0	0	0	0
BRAZIL	69	49	82	0	7	55	0	0	0	299	410	0	64	169	0
CHILE	31	2	10	0	0	7	3	4	0	60	5	0	24	17	0
COLOMBIA	17	6	8	0	9	0	0	0	0	108	4	0	32	45	0
ECUADOR	13	4	12	12	0	0	4	0	0	10	26	0	1	8	0
FRENCH GUIANA	4	1	3	0	0	0	0	2	0	3	0	0	9	0	0
GUYANA	4	0	2	0	2	0	0	0	0	0	0	0	0	1	0
PANAMA	7	0	1	1	4	1	4	0	0	2	2	0	2	10	0
PARAGUAY	7	2	3	3	4	2	0	2	0	9	3	0	0	0	0
PERU	17	0	15	0	2	2	13	0	0	34	8	0	36	12	0
SURINAME	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0
URUGUAY	10	5	3	0	10	0	0	0	0	38	0	0	2	0	0
VENEZUELA	6	1	5	0	0	16	0	13	0	12	16	0	1	0	0
Totales	239	92	205	69	50	83	24	21	0	677	503	0	210	302	0

Fuente/Source: Encuestas de la Oficina Regional Sudamericana de la OACI y AIP del Estado/ CAR/SAM ANP / ICAO South American Office Surveys and States' AIP / ANP CAR/SAM.

Nota/Note: Información al 31 de agosto de 2013 / Information by 31 August 2013.

APPENDIX E

(Doc 8168 Flight Procedures – Aircraft Operations – Volume I, III-1-2-1)

Chapter 2

BASIC ALTIMETER SETTING REQUIREMENTS

2.1.2 Transition altitude

2.1.2.1 A transition altitude shall normally be specified for each aerodrome by the State in which the aerodrome is located.

2.1.2.2 Where two or more closely spaced aerodromes are located so that coordinated procedures are required, a common transition altitude shall be established. This common transition altitude shall be the highest that would be required if the aerodromes were considered separately.

2.1.2.3 As far as possible, a common transition altitude should be established:

- a) for groups of aerodromes of a State or all aerodromes of that State;
- b) on the basis of an agreement, for:
 - 1) aerodromes of adjacent States;
 - 2) States of the same flight information region; and
 - 3) States of two or more adjacent flight information regions or one ICAO region; and
- c) for aerodromes of two or more ICAO regions when agreement can be obtained between these regions.

2.1.2.4 The height above the aerodrome of the transition altitude shall be as low as possible but normally not less than 900 m (3 000 ft).

2.1.2.5 The calculated height of the transition altitude shall be rounded up to the next full 300 m (1 000 ft).

2.1.2.6 Despite the provisions in 2.1.2. “Transition altitude”, a transition altitude may be established for a specified area on the basis of regional air navigation agreements.

2.1.2.7 Transition altitudes shall be published in aeronautical information publications and shown on the appropriate charts.

Agenda Item 3: Criteria and procedures for the approval of performance-based navigation operations

Progress of the works carried out under RLA/99/901 Project regarding performance-based navigation (PBN)

3.1 In reference to this matter, the Meeting noted the progress of the works carried out by the Regional Safety Oversight Cooperation System (SRVSOP) in Latin America, with regard to the development of aircraft and operators approval for RNAV and RNP operations Advisory Circulars (CA).

3.2 Likewise, the Meeting was informed on the amendments performed to the Fourth Edition of Doc 9613 – *Performance-based Navigation (PBN) Manual*, as well as on the development of following Advisory Circulars: CA 91-005 – *Aircraft and operator approval for RNP 2 operations* and CA 91-006 – *Aircraft and operator approval for RNP 1 operations*. With reference to the latter CA, the Meeting noted that the previous Advisory Circular related to basic RNP 1 was cancelled and replaced by the Advisory Circular RNP 1, as ICAO eliminated prefix “basic” from this navigation specification. Likewise, the Meeting noted the inclusion of following functionalities in Advisory Circulars: “Fixed radius transition (FRT)”, in CA 91-005 (RNP 2) and “Constant radius arc to a fix/Radius to a fix (RF)”, in CA 91-006 (RNP 1).

3.3 The Meeting discussed on the situations in which an assessment should be made on flight operations safety (FOSA), as well as on the approaches required during the provisional period of approval of a RNP AR APCH operation.

3.4 The Secretariat informed that according to ICAO Doc 9997 – *Performance-based Navigation (PBN) operational approval Manual*, a FOSA should be performed for each RNP AR approach procedure for which more demanding aspects than the nominal design procedure criteria are applied (according to Doc 9905 – *Required navigation performance authorization required (RNP AR) procedure design Manual*), (for example, RF segments after FAF, missed approaches with RNP less than 1.0, final approaches with RNP less than 0.3), or when the application of a design procedure criteria by implicit logic, is performed in an operational environment with special challenges or demands, such as approaches in high or mountainous terrain or other difficult conditions, or approaches in environments with a high and complex traffic density.

3.5 With reference to the required approaches to be accomplished by an operator during the provisional approval period of a RNP AR APCH procedure (with a RNP 0.3 minima line before final approval of RNP less than 0.3 minima lines is granted), the Meeting was informed that according to SRVSOP’s CA 91-009, approaches are applied by type of aircraft and not by airport, or procedure, or individual runway. The requirement of at least 100 approaches (according to SRVSOP’s CA 91-009) is the sum of all RNP AR APCH procedures performed by the operator with a RNP 0.3 minima line in a same type of aircraft, provided that the procedures are public and have been approved by the authorities concerned.

3.6 Once the Meeting ended with the discussions of this Agenda Item, it agreed to adopt CA 91-005 and CA 91-006, to serve as guidance material for States of the South American Region.

3.7 The amended work programme is shown in **Appendix A**, and the Advisory Circulars in **Appendix B** to this part of the Report.

**SRVSOP WORK PROGRAMME IN SUPPORT OF THE IMPLEMENTATION OF
PERFORMANCE-BASED NAVIGATION (PBN)**

CA Number	Navigation specifications	Titles	Revision and date
CA 91-001	RNAV 10 (Designed and authorized as RNP 10)	Aircraft and operator approval for RNP 10 operations	
CA 91-002	RNAV 5	Aircraft and operator approval for RNAV 5 operations	
CA 91-003	RNAV 1 and RNAV 2	Aircraft and operator approval for RNAV 1 and RNAV 2 operations	
CA 91-004	RNP 4	Aircraft and operator approval for RNP 4 operations	
CA 91-005 <i>New CA</i>	RNP 2	Aircraft and operator approval for RNP 2 operations	SAM/IG/12
CA 91-006 <i>Amended CA Supersedes RNP 1 Basic CA</i>	RNP 1	Aircraft and operator approval for RNP 1 operations	SAM/IG/12
CA 91-007 <i>New CA</i>	A-RNP (Advanced RNP)	Aircraft and operator approval for advanced RNP operations	SAM/IG/13
CA 91-008	RNP APCH up to LNAV and LNAV/VNAV minima	Aircraft and operator approval for RNP APCH up to LNAV and LNAV/VNAV minima operations	
CA 91-009	RNP AR APCH	Aircraft and operator approval for RNP AR APCH operations	

CA 91-010	APV/baro-VNAV	Aircraft and operator approval for Approach procedure with vertical guidance/Barometric vertical navigation (APV/baro-VNAV) operations	
CA 91-011	RNP APCH up to LP and LPV minima	Aircraft and operator approval for RNP APCH up to LP and LPV minima operations	
CA 91-012 <i>New CA</i>	RNP 0.3	Aircraft and operator approval for RNP 0.3 operations	SAM/IG/13

APPENDIX B

- ✓ **CA 91-005 – Aircraft and operator approval for RNP 2 operations**
- ✓ **CA 91-006 – Aircraft and operator approval for RNP 1 operations**

ADVISORY CIRCULAR

CA : 91-005
DATE : 16/09/13
REVISION : Original
ISSUED BY : SRVSOP

SUBJECT: AIRCRAFT AND OPERATOR APPROVAL FOR RNP 2 OPERATIONS

1. PURPOSE

This advisory circular (AC) establishes criteria on aircraft and operators approval for RNP 2 operations.

An operator may use alternate means of compliance, provided those means are acceptable to the Civil Aviation Administration (CAA).

The future tense of the verb or the term "shall" apply to operators who choose to meet the criteria set forth in this AC.

2. RELEVANT SECTIONS OF THE LATIN AMERICAN AERONAUTICAL REGULATIONS (LAR) OR EQUIVALENT

LAR 91: Sections 91.1015 and 91.1640 or equivalents

LAR 121: Section 121.995 (b) or equivalent

LAR 135: Section 135.565 (c) or equivalent

3. RELATED DOCUMENTS

Annex 6	Operation of aircraft Part I – International commercial air transport – Aeroplanes Part II – International general aviation - Aeroplanes
Annex 10	Aeronautical communications Volume I: Radio navigation aids
Annex 15	Aeronautical information services
ICAO Doc 9613	Performance based navigation (PBN) manual
ICAO Doc 4444	Procedures for air navigation services – Air traffic management (PANS-ATM)
ICAO Doc 8168	Procedures for air navigation services - Aircraft operations Volume I: Flight procedures Volume II: Construction of visual and instrument flight procedures

4. DEFINITIONS AND ABBREVIATIONS

4.1 Definitions

- a) **Aircraft-based augmentation system (ABAS).**- A system which augments and/or integrates the information obtained from the other GNSS elements with information available on board the

aircraft. The most common form of ABAS is the receiver autonomous integrity monitoring (RAIM).

- b) **Area navigation (RNAV).**- A navigation method that allows aircraft to operate on any desired flight path within the coverage of ground or space-based navigation aids, or within the limits of the capability of self-contained aids, or a combination of both methods.

Note.- Area navigation includes performance-based navigation as well as other RNAV operations that do not meet the definition of performance-based navigation.

- c) **Flight technical error (FTE).**- The FTE is the accuracy with which an aircraft is controlled, as measured by the indicated aircraft position with respect to the indicated command or desired position. It does not include procedural blunder errors.
- d) **Global navigation satellite system (GNSS).**- A generic term used by the International Civil Aviation Organization (ICAO) to define any global position, speed, and time determination system that includes one or more main satellite constellations, such as GPS and the global navigation satellite system (GLONASS), aircraft receivers and several integrity monitoring systems, including aircraft-based augmentation systems (ABAS), satellite-based augmentation systems (SBAS), such as the wide area augmentation systems (WAAS), and ground-based augmentation systems (GBAS), such as the local area augmentation system (LAAS).

Distance information will be provided, at least in the immediate future, by GPS and GLONASS.

- e) **Global positioning system (GPS).**- The global positioning system (GNSS) of the United States is a satellite-based radio navigation system that uses precise distance measurements to determine the position, speed, and time in any part of the world. The GPS is made up by three elements: the spatial, the control, and the user elements. The GPS spatial segment nominally consists of, at least, 24 satellites in 6 orbital planes. The control element consists of 5 monitoring stations, 3 ground antennas, and one main control station. The user element consists of antennas and receivers that provide the user with position, speed, and precise time.
- f) **Navigation specifications.**- Set of aircraft and flight crew requirements needed to support performance-based navigation operations within a defined airspace. There are two kinds of navigation specifications:

Required Navigation Performance (RNP) Specification.- A navigation specification based on area navigation that includes the requirement for on-board performance monitoring and alerting, designated by the prefix RNP; e.g., RNP 4, RNP APCH, RNP AR APCH.

Area Navigation (RNAV) Specification.- A navigation specification based on area navigation that does not include the requirement for on-board performance monitoring and alerting, designated by the prefix RNAV; e.g., RNAV 5, RNAV 2, RNAV 1.

Note 1.- The Manual on Performance-based Navigation (PBN) (Doc 9613), Volume II, contains detailed guidelines on navigation specifications.

Note 2.- The term RNP, formerly defined as "a statement of the navigation performance necessary for operation within a defined airspace", has been deleted from the Annexes to the Convention on International Civil Aviation because the RNP concept has been replaced by the PBN concept. In said Annexes, the term RNP is now only used within the context of the navigation specifications that require on-board performance control and alerting; e.g., RNP 4 refers to the aircraft and the operational requirements, including a lateral performance of 4 nautical miles (NM), with the requirement for on-board performance control and alerting as described in the PBN Manual of the International Civil Aviation Organization (ICAO) (Doc 9613).

- g) **Navigation system error (NSE).**- The difference between the true position and the estimated position.
- h) **Path definition error (PDE).**- The difference between the defined path and the desired path at a given place and time.
- i) **Performance-based navigation (PBN).**- Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure, or in a designated airspace.

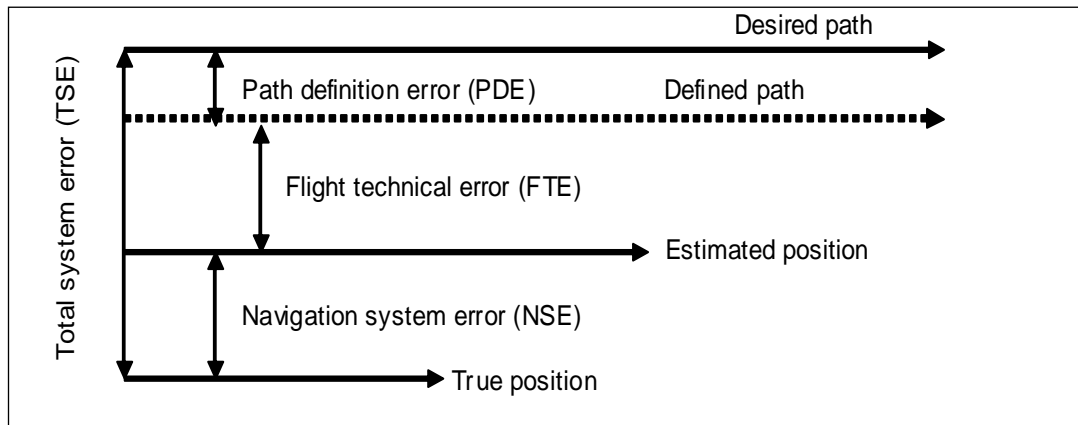
Note.- Performance requirements are expressed in navigation specifications (RNAV and RNP specifications) in terms of

accuracy, integrity, continuity, availability, and functionality needed for the proposed operation in the context of a particular airspace concept.

- j) **Receiver autonomous integrity monitoring (RAIM).**- A technique used in a GPS receiver/processor to determine the integrity of its navigation signals, using only GPS signals or GPS signals enhanced with barometric altitude data. This determination is achieved by a consistency check among redundant pseudo-range measurements. At least one additional available satellite is required with respect to the number of satellites that are needed for the navigation solution.
- k) **RNP operations.**- Aircraft operations that use an RNP system for RNP navigation applications.
- l) **RNP system.**- An area navigation system that supports on-board performance monitoring and alerting.
- m) **Total system error (TSE).**- The difference between the true position and the desired position. This error is equal to the vector sum of the path definition error (PDE), flight technical error (FTE), and navigation system error (NSE).

Note.- On occasions, the FTE is known as path steering error (PSE), and the NSE as position estimation error (PEE).

Total system error (TSE)



- n) **Waypoint (WPT).** A specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. Waypoints are identified as either:

Fly-by waypoint. - A waypoint which requires turn anticipation to allow tangential interception of the next segment of a route or procedure.

Fly over waypoint. - A waypoint at which a turn is initiated in order to join the next segment of a route or procedure.

4.2 Abbreviations

- a) AAC Civil Aviation Administration/Civil Aviation Authority
- b) ABAS Aircraft-based augmentation system
- c) AC Advisory circular (FAA)
- d) AFM Aircraft flight manual
- e) A-RNP Advanced RNP
- f) AIP Aeronautical information publication
- g) AIRAC Aeronautical information regulation and control
- h) ANSP Air navigation service providers
- i) AP Automatic pilot

j)	APV	Approach procedure with vertical guidance
k)	APV/baro-VNAV	Approach procedure with vertical guidance/Barometric vertical navigation
l)	ARP	Aerodrome reference point
m)	ATC	Air traffic control
n)	ATM	Air traffic management
o)	ATS	Air traffic service
p)	baro-VNAV	Barometric vertical navigation
q)	CA	Advisory circular (SRVSOP)
r)	CA	Course to an altitude
s)	CDI	Course deviation indicator
t)	CDU	Control and display unit
u)	CF	Course to a fix
v)	Doc	Document
w)	DCPC	Direct controller-pilot communication
x)	DF	Direct to a fix
y)	DME	Distance-measuring equipment
z)	DV	Flight dispatcher (SRVSOP)
aa)	EASA	European Aviation Safety Agency
bb)	EHSI	Electronic horizontal situation indicator
cc)	FAA	Federal Aviation Administration (United States)
dd)	FAF	Final approach fix
ee)	FAP	Final approach point
ff)	FD	Flight director
gg)	FM	Fix to a manual termination
hh)	Fly-by WPT	Fly-by way-point
ii)	Flyover WPT	Flyover way-point
jj)	FMS	Flight management system
kk)	FRT	Fixed radius transition
ll)	FTE	Flight technical error
mm)	GA	General aviation
nn)	GBAS	Ground-based augmentation system
oo)	GNSS	Global navigation satellite system
pp)	GLONASS	Global navigation satellite system
qq)	GPS	Global positioning system
rr)	GS	Ground speed
ss)	HAL	Horizontal alerting limit

tt)	HSI	Horizontal situation indicator
uu)	IF	Initial fix
vv)	IFR	Instrument flight rules
ww)	IMC	Instrument meteorological conditions
xx)	LAAS	Local area augmentation system
yy)	LAR	Latin American Aeronautical Regulations
zz)	LNAV	Lateral navigation
aaa)	LOA	Letter of authorisation/letter of acceptance
bbb)	MCDU	Multifunction control and display unit
ccc)	MEL	Minimum equipment list
ddd)	MIO	Operations inspector manual (SRVSOP)
eee)	NM	Nautical mile
fff)	MP	Monitoring pilot
ggg)	NAVAID	Navigation aid
hhh)	NOTAM	Notice to airmen
iii)	NPA	Non-precision approach
jjj)	NSE	Navigation system error
kkk)	LNAV	Lateral navigation
lll)	OACI	International Civil Aviation Organization
mmm)	OM	Operations manual
nnn)	OEM	Original equipment manufacturer
ooo)	OpSpecs	Operations specifications
ppp)	PA	Precision approach
qqq)	PANS-ATM	Procedures for Air Navigation Services - Air traffic management
rrr)	PANS-OPS	Procedures for Air Navigation Services - Aircraft operations
sss)	PBN	Performance-based navigation
ttt)	PDE	Path definition error
uuu)	PEE	Position estimation error
vvv)	PF	Pilot flying
www)	PNF	Pilot not flying
xxx)	POH	Pilot operating handbook
yyy)	P-RNAV	Precision area navigation
zzz)	PSE	Path steering error
aaaa)	RAIM	Receiver autonomous integrity monitoring
bbbb)	RF	Constant radius arc to a fix / Radius to a fix
cccc)	RNAV	Area navigation
dddd)	RNP	Required navigation performance

eeee)	RNP APCH	Required navigation performance approach
ffff)	RNP AR APCH	Required navigation performance authorisation required approach
gggg)	RTCA	Radio Technical Commission for Aviation
hhhh)	SBAS	Satellite-based augmentation system
iiii)	SID	Standard instrument departure
jjjj)	SIS	Signal-in-space
kkkk)	SRVSOP	Regional Safety Oversight Cooperation System
llll)	STAR	Standard instrument arrival
mmmm)	STC	Supplemental type certificate
nnnn)	TF	Track to a fix
oooo)	TO/FROM	To/from
pppp)	TSE	Total system error
qqqq)	TSO	Technical standard order
rrrr)	VA	Heading to an altitude
ssss)	VI	Heading to an intercept
tttt)	VM	Heading to a manual termination
uuuu)	VMC	Visual meteorological conditions
vvvv)	VNAV	Vertical navigation
wwww)	WAAS	Wide area augmentation system
xxxx)	WGS	World geodetic system
yyyy)	WPT	Waypoint

5. INTRODUCTION

5.1 The RNP 2 navigation specification is primarily intended for a diverse set of en-route applications, particularly in geographic areas with little or no ground NAVAID infrastructure and with limited or no ATS surveillance.

5.2 The RNP 2 is used to support RNP operations in the en-route phase of flight in oceanic, remote and continental airspace.

5.3 Use of RNP 2 in continental applications requires a lower continuity requirement than used in oceanic/remote applications.

5.4 In oceanic/remote applications, the target traffic is primarily transport category aircraft operating at high altitude, whereas, continental applications may include a significant percentage of general aviation (GA) aircraft.

5.5 Remote airspace may require different considerations for aircraft eligibility based on whether the remote areas support suitable landing airports for the target aircraft population or support reversion to an alternate means of navigation. Thus for remote airspace applications, the CAA may choose to designate either continental or oceanic/remote aircraft eligibility.

5.6 RNP 2 is applicable to area navigation routes defined by straight segments; however RNP 2 can be associated with fixed radius transition (FRT). When FRT are incorporated into RNP 2 routes, the Appendix 4 of this AC provides criteria for the approval of this capability.

5.7 This AC does not address all the requirements that may be specified for particular

operation. These requirements are established in other documents, such as the aeronautical information publication (AIP) and ICAO Doc 7030 – Regional Supplementary Procedures.

5.8 While operational approval primarily relates to the navigation requirements of the airspace, the operators and pilots must consider all operational documents relating to the airspace, which are required by the CAA, before conducting flights into RNP 2 airspace.

5.9 The material described in this CA has been developed based on the following document:

- ✓ ICAO Doc 9613, Volume II, Part C, Chapter 2 – Implementing RNP 2.

6. GENERAL CONSIDERATIONS

6.1 Navigation aid infrastructure

- a) The RNP 2 specification is based upon GNSS.
- b) Operators relying on GNSS are required to have the means to predict the availability of GNSS fault detection (e.g. ABAS RAIM) to support operations along the RNP 2 ATS route.
- c) The ANSP or other entities may provide a prediction capability for the on-board RNP system and GNSS avionics.
- d) The AIP should clearly indicate when prediction capability is required and an acceptable means to satisfy that requirement.
- e) RNP 2 shall not be used in areas of known GNSS signal interference.
- f) The ANSP must undertake an assessment of the NAVAID infrastructure.
- g) The infrastructure should be sufficient for the proposed operations, including reversionary navigation modes the aircraft may apply.

6.2 Communications and ATS surveillance

- a) This navigation specification is primarily intended for environments where ATS surveillance is either not available or limited.
- b) Communications performance on RNP 2 routes will be commensurate with operational considerations such as route spacing, traffic density, complexity and contingency procedures.

6.3 Obstacle clearance, route spacing and horizontal separation

- a) Guidance on obstacle clearance is provided in PANS-OPS (Doc 8168, Volume II); the general criteria in Parts I and III apply, and assume normal operations.
- b) The route spacing supported by this AC will be determined by a safety study for the intended operations which will depend on the route configuration, air traffic density and intervention capability, etc. Horizontal separation standards are published in PANS-ATM (Doc 4444).

6.4 Publications

- a) An RNP 2 route should rely on normal flight profiles and identify minimum segment altitude requirements.
- b) The navigation data published in the State AIP for the routes must meet the requirements of Annex 15 - *Aeronautical Information Services*.
- c) The State should define all RNP 2 routes using WGS-84 coordinates.
- d) The AIP should clearly indicate whether the navigation application is RNP 2.
- e) The available navigation infrastructure shall be clearly designated in all the appropriate charts (e.g., GNSS).
- f) The required navigation standard (e.g., RNP 2) for all RNP 2 routes shall be clearly designated in all the appropriate charts.

6.5 Additional considerations

- a) It is important that the ANSP, in establishing the RNP 2 routes, consider the factors determining the location of routes, the availability of diversions, etc. These factors determine whether the ATS routes are being applied in continental or oceanic/remote airspace, and this must be clearly identified in the State's AIP.
- b) The area of application (i.e. continental or oceanic/remote) will determine the applicable RNP continuity requirement.
- c) An aircraft configuration that does not meet the higher continuity requirements for oceanic/remote will be limited to operate on continental RNP 2 routes only.

7. AIRWORTHINESS AND OPERATIONAL APPROVAL

7.1 For a commercial air transport operator to be granted a RNP 2 approval, it must comply with two types of approvals:

- a) the airworthiness approval, issued by the State of registry; and
- b) the operational approval, issued by the State of the operator.

7.2 For general aviation operators, the State of registry will determine whether or not the aircraft meets the applicable RNP 2 requirements and will issue the operational approval (e.g., letter of authorisation – LOA).

7.3 Before filing the application, operators shall review all aircraft qualification requirements. Compliance with airworthiness requirements or equipment installation alone does not constitute operational approval.

8. AIRWORTHINESS APPROVAL

8.1 Aircraft and eligibility requirements

8.1.1 General

- a) RNP 2 navigation specification requires GNSS as the primary navigation sensor, either as a stand-alone navigation system or as part of a multi-sensor system.
- b) Where multi-sensor system incorporating GNSS are used, positioning data from non-GNSS navigation sensors may be integrated with the GNSS data provided the non-GNSS data do not cause position errors exceeding the total system error budget. Otherwise a means should be provided to deselect the non-GNSS navigation sensor types.
- c) RNP 2 operations in oceanic and remote airspace require dual independent long-range navigation systems.
- d) RNP 2 operations in continental en-route airspace may use a single GNSS, provided an alternate means of navigation is available and if required by the category of operation.
- e) For RNP 2 operations on-board performance monitoring and alerting is required. This section provides the criteria for a TSE form of performance monitoring and alerting that will ensure a consistent evaluation and assessment of compliance for RNP 2 applications.
- f) The aircraft navigation system, or aircraft navigation system and pilot in combination, are required to monitor the TSE, and to provide an alert if the accuracy requirement is not met or if the probability that the lateral TSE exceeds two times the accuracy value is larger than 1×10^{-5} . To the extent operational procedures must be used to satisfy this requirement, the crew procedure, equipment characteristics and installation should be evaluated for their effectiveness and equivalence. Examples of information provided to the pilot for awareness of navigation system performance include "EPU", "ACTUAL", "ANP" and "EPE". Examples of indications and alerts provided when the operational requirement is or can be determined as not being met include "UNABLE RNP", "Nav Accur Downgrad", GNSS alert limit, loss of GNSS integrity, TSE

monitoring (real time monitoring of NSE and FTE combined), etc. The navigation system is not required to provide both performance and sensor-based alerts, e.g. if a TSE-based alert is provided, a GNSS alert may not be necessary.

- g) The aircraft eligibility must be determined through demonstration of compliance against the relevant airworthiness criteria and the requirements establish in this section.
- h) The original equipment manufacturer (OEM) or the holder of installation approval for the aircraft, e.g. STC holder, will demonstrate compliance to their CAA (e.g. EASA, FAA) and the approval can be documented in manufacturer documentation (e.g. service letters).
- i) AFM entries are not required provided the State accepts manufacturer documentation.
- j) In this navigation specification, the continuity requirements for oceanic/remote and continental applications are different [see 8.1.2 c)].
- k) Where an aircraft is eligible for continental applications only, such a limitation must be clearly identified to support operational approvals.
- l) Aircraft meeting the oceanic/remote continuity requirement also meet the continental continuity requirement.
- m) A-RNP systems are considered as qualified for RNP 2 continental applications without further examination, and for RNP 2 oceanic/remote applications provided the oceanic/remote continuity requirement has been met.

Note.- Requests for approval to use optional functionality (e.g. FRT) should address the aircraft and operational requirements as described in Appendix 4.

8.1.2 System performance, control, and alerting

- a) **Accuracy.-** During operations in airspace or on routes designated as RNP 2, the lateral TSE must be within ± 2 NM for at least 95 per cent of the total flight time. The along-track error must also be within ± 2 NM for at least 95 per cent of the total flight time. To satisfy the accuracy requirement, the 95 per cent FTE should not exceed 1 NM.

Note.- The use of a deviation indicator with 2 NM full-scale deflection is an acceptable means of compliance.

- b) **Integrity.-** Malfunction of the aircraft navigation equipment is classified as a major failure condition under airworthiness guidance material (i.e. 10^{-5} per hour).
- c) **Continuity.-** For RNP 2 oceanic/remote continental airspace applications, loss of function is a major failure condition. For RNP 2 continental applications, loss of function is a minor failure condition if the operator can revert to a different navigation system and proceed to a suitable airport. If a single aircraft configuration is to support all potential applications of RNP 2, the more stringent continuity requirement applies. The AFM limitations section must reflect restrictions in capability to aid in operational approvals.
- d) **Signal-in-space (SIS).-** The aircraft navigation equipment shall provide an alert if the probability of SIS errors causing a lateral position error greater than 4 NM exceeds 1×10^{-7} per hour.

8.1.3 Flight technical error (FTE)

- a) During the aircraft certification process, the manufacturer must demonstrate the ability of the pilot to operate the aircraft within the allowable FTE. The demonstration of FTE should account for the aircraft type, the operating envelope, aircraft displays, autopilot performance, and flight guidance characteristics. When this is done, the pilot may use the demonstrated value of FTE to monitor compliance to the RNP requirements. This value must be the cross-track distance to the defined path. For cross-track containment compliance, the demonstration should account for any inaccuracies in the cross-track error computation (e.g. resolution) in the TSE.

8.1.4 Path definition error (PDE)

- a) The PDE is considered negligible because a quality assurance process is applied at the navigation database level.

8.1.5 Aircraft eligibility requirements for RNP 2 operations

The aircraft is eligible for RNP 2 operations if:

- a) the AFM, an AFM supplement or OEM service letter states that the aircraft navigation system is approved for RNP 2 operations; or
- b) the aircraft is equipped with GNSS stand-alone system using E/TSO-C129a Class A1 or A2 or E/TSO-C146 () Class Gamma and Operational Class 1, 2 or 3, installed for IFR use in accordance with FAA AC 20-138A or AC 20-138B; or
- c) the aircraft is equipped with a multi-sensor system (e.g. FMS) with GNSS equipment using E/TSO-C129a sensor Class B or C or E/TSO-C145 () Class 1, 2 or 3. The GNSS system must be installed in accordance with AC 20-138A and the associated FMS must comply with E/TSO-C115b and AC 20-130A.

8.2 Qualification documentation

a) Aircraft qualification documentation

- 1) Aircraft or avionics manufacturers must produce aircraft qualification documentation showing compliance with the applicable criteria, as appropriate. For aircraft not approved for flying RNP 2 operations, aircraft and avionics manufacturers must develop aircraft qualification documentation showing compliance with this AC, provided the equipment is properly installed and operated. The necessary documentation shall also define the appropriate maintenance procedures. This documentation is not required for aircraft that have an AFM or AFM supplement that explicitly states that the RNP system is approved for operations with values of RNP 2 or lower, and that the equipment meets the reliability and performance requirements of the following documents: AC 20-138A, AC 20-138B, AC 20-130A and E/TSO C115b, as applicable.
- 2) Operators will submit this documentation, together with the formal application, in Phase 2 of the approval process.

b) Acceptance of documentation by the CAA

- 1) *For new aircraft/equipment (capability shown in production).*- The new aircraft/equipment qualification documentation may be approved as part of an aircraft certification project, and will be reflected in the AFM and related documents.
- 2) *For aircraft/equipment in use.*- For installations/equipment that are not eligible for conducting RNP 2 operations, the operator shall send the RNP 2 and aircraft qualification documentation to the corresponding bodies of the CAA (e.g., Aircraft certification division or Airworthiness inspection division, or equivalents).
- 3) The corresponding bodies of the CAA, as appropriate, will accept the data package for RNP 2 operations. This acceptance will be documented in a letter to the operator.

8.3 Functional requirements

Appendix 1 contains the functional requirements that meet the criteria of this AC.

8.4 Continued airworthiness

- a) The operators of aircraft approved to perform RNP 2 operations, must ensure the continuity of the technical capacity of them, in order to meet technical requirements established in this AC.
- b) Each operator who applies for RNP 2 operational approval shall submit to the CAA of State of registry, a maintenance and inspection program that includes all those requirements of maintenance necessary to ensure that navigation systems continue fulfilling the RNP 2 approval criteria.
- c) The following maintenance documents must be revised, as appropriate, to incorporate RNP 2 aspects:

- 1) Maintenance control manual (MCM);
 - 2) Illustrated parts catalogs (IPC); and
 - 3) Maintenance program.
- d) The approved maintenance program for the affected aircrafts should include maintenance practices listed in maintenance manuals of the aircraft manufacturer and its components, and must consider:
- 1) that equipment involved in the RNP 2 operation should be maintained according to directions given by manufacturer's components;
 - 2) that any amendment or change of navigation system affecting in any way RNP 2 initial approval, must be forwarded and reviewed by the CAA for its acceptance or approval of such changes prior to its implementation; and
 - 3) that any repair that is not included in the approved/accepted maintenance documentation, and that could affect the integrity of navigation performance, should be forwarded to the CAA for acceptance or approval thereof.
- e) Within the RNP 2 maintenance documentation must be presented the training program of maintenance personnel, which inter alia, should include:
- 1) PBN concept;
 - 2) RNP 2 application;
 - 3) equipment involved in an RNP 2 operation; and
 - 4) MEL use.

9. OPERATIONAL APPROVAL

Airworthiness approval alone does not authorise an applicant or operator to conduct RNP 2 operations. In addition to the airworthiness approval, the applicant or operator must obtain an operational approval to confirm the suitability of normal and contingency procedures in connection to the installation of a given piece of equipment.

Concerning commercial air transport, the assessment of an application for RNP 2 operational approval is done by the State of the operator, in accordance with standing operating rules [e.g., LAR 121.995 (b) and LAR 135.565 (c)] or equivalents supported by the criteria described in this AC.

For general aviation, the assessment of an application for RNP 2 operational approval is carried out by the State of registry, in accordance with standing operating rules (e.g., LAR 91.1015 and LAR 91.1640 or equivalents) supported by the criteria established in this AC.

9.1 Requirements to obtain operational approval

9.1.1 In order to obtain RNP 2 approval, the applicant or operator will take the following steps, taking into account the criteria established in this paragraph and in Paragraphs 10, 11, 12, and 13:

- a) *Airworthiness approval.*- Aircraft shall have the corresponding airworthiness approvals, pursuant to Paragraph 8 of this CA.
- b) *Application.*- The operator shall submit the following documentation to the CAA:
 - 1) *RNP 2 operational approval application;*
 - 2) *Description of aircraft equipment.*- The operator shall provide a configuration list with details of the relevant components and the equipment to be used for RNP 2 operations. The list shall include each manufacturer, model, and equipment version of GNSS equipment and software of the installed FMS.

- 3) *Airworthiness documents related to aircraft eligibility.*- The operator shall submit relevant documentation, acceptable to the CAA, showing that the aircraft is equipped with RNP systems that meet the RNP 2 requirements, as described in Paragraph 8 of this AC. For example, the operator will submit the parts of the AFM or AFM supplement that contain the airworthiness statement.
 - 4) *Training programme for flight crews and flight dispatchers (DV)*
 - (a) Commercial operators (e.g., LAR 121 and LAR 135 operators) will present to the CAA the RNP 2 training curriculums to show that the operational procedures and practices and the training aspects described in Paragraph 11 have been included in the initial, upgrade or recurrent training curriculums for flight crews and DV.

Note.- It is not necessary to establish a separate training programme if the RNP 2 training identified in Paragraph 11 has already been included in the training programme of the operator. However, it must be possible to identify what aspects of RNP 2 are covered in the training programme.
 - (b) Private operators (e.g., LAR 91 operators) shall be familiar with and demonstrate that they will perform their operations based on the practices and procedures described in Paragraph 11.
 - 5) *Operations manual and checklists*
 - (a) Commercial operators (e.g., LAR 121 and 135 operators) must review the operations manual (OM) and the checklists in order to include information and guidance on the operating procedures detailed in Paragraph 10 of this AC. The appropriate manuals must contain the operating instructions for navigation equipment and contingency procedures. The manuals and checklists must be submitted for review along with the formal application in Phase 2 of the approval process.
 - (b) Private operators (e.g., LAR 91 operators) must operate their aircraft based on the practices and procedures identified in Paragraph 10 of this CA.
 - 6) *Minimum Equipment List (MEL).*- The operator will send to the CAA for approval any revision to the MEL that is necessary to conduct RNP 2 operations. If a RNP 2 operational approval is granted based on a specific operational procedure, operators must modify the MEL and specify the required dispatch conditions.
 - 7) *Maintenance.*- The operator will submit for approval a maintenance programme to conduct RNP 2 operations.
 - 8) *Training programme for maintenance personnel.*- Operators will submit the training curriculums that correspond to maintenance personnel in accordance with Paragraph 8.4 e).
 - 9) *Navigation data validation programme.*- The operator will present the details about the navigation data validation programme as described in Appendix 2 to this AC.
- c) *Training.*- Once the amendments to manuals, programmes, and documents submitted have been accepted or approved, the operator will provide the required training to its personnel.
 - d) *Validation flight.*- The CAA may deem it advisable to perform a validation flight before granting the operational approval. Such validation can be performed on commercial flights. The validation flight will be carried out according to Chapter 12, Volume II, Part II of the operations inspector manual (MIO) of the Regional Safety Oversight Cooperation System (SRVSOP).
 - e) *Issuance of the approval to conduct RNP 2 operations.*- Once the operator has successfully completed the operational approval process, the CAA will grant the operator the authorization to conduct RNP 2 operations.
 - 1) LAR 121 and/or 135 operators.- For LAR 121 and/or LAR 135 operators, the CAA will issue the corresponding operations specifications (OpSpecs) that will reflect the RNP 2 approval.
 - 2) LAR 91 operators.- For LAR 91 operators, the CAA will issue a letter of authorization

(LOA).

10. OPERATING PROCEDURES

10.1 The operator and flight crews will become familiar with the following operating and contingency procedures associated with RNP 2 operations.

a) Pre-flight planning

- 1) Operators and pilots intending to conduct operations on RNP 2 routes must file the appropriate flight plan suffixes.
- 2) The on-board navigation data must be current and include appropriate procedures. Navigation databases should be current for the duration of the flight. If the AIRAC cycle is due to change during flight, operators and pilots should establish procedures to ensure the accuracy of the navigation data, including the suitability of navigation facilities defining the routes and procedures for flight.
- 3) The operator must confirm the availability of the NAVAID infrastructure, required for the intended routes, including those for use in a non-GNSS contingency, for the period of intended operations using all available information. Since Annex 10 requires GNSS integrity (RAIM or SBAS signal), the procedures should determine the availability of these services and functions as appropriate. For aircraft navigating with SBAS capability (all TSO-C145()/C146()), operators should check appropriate GNSS RAIM availability in areas where the SBAS signal is unavailable.
- 4) RAIM (ABAS) availability
 - (a) RAIM levels required for RNP 2 can be verified either through NOTAMs (where available) or through prediction services. Operators must be familiar with the prediction information available for the intended route.
 - (b) For systems whose integrity is based on RAIM, RAIM prediction must be done before departure. This capability can be provided by a ground service or through the RAIM prediction capability of the aircraft on-board receiver.
 - (c) The prediction of RAIM availability must take into account the last NOTAMs of the GPS constellation and the avionics model (if available). The RAIM prediction service can be provided through the ANSPs, the avionics manufacturers, other entities, or through the RAIM prediction capability of the aircraft on-board receiver. RAIM availability can be confirmed using a model-specific RAIM prediction software.
 - (d) The predictive capability must account for known and predicted outages of GPS satellites or other effects on the navigation system sensors. The prediction programme should not use a mask angle below 5 degrees, since operational experience indicates that satellite signals on low elevations are not reliable. RAIM availability prediction should take into account the latest GPS constellation notices to airmen (NOTAMs) issued by the CAA or by the ANSPs, and use an identical algorithm to that used in the airborne equipment or an algorithm based on assumptions for RAIM prediction that provides a more conservative result.
 - (e) In the event that a continuous loss of the appropriate failure detection level is forecast for more than five (5) minutes for any portion of the RNP 2 operation, the flight plan shall be revised (e.g., delaying the departure or planning a different departure procedure).
 - (f) The RAIM availability prediction software does not guarantee the service. This software is rather a tool for assessing the expected capacity to meet the required navigation performance. Due to unplanned failures of some GNSS elements, pilots and ANSPs must understand that both RAIM and GNSS navigation can be lost

while the aircraft is on flight, which may require reversal to an alternate means of navigation. Therefore, pilots must assess their navigation capabilities (potentially to an alternate aerodrome) in case of failure of GNSS navigation. If system integrity needs to be verified, the RAIM prediction programme shall meet the criteria of FAA AC 20-138, Paragraph 12.

- (g) For aircraft navigating with SBAS receivers (all E/TSO-C145/C146), operators must take into account the latest GPS constellation and SBAS NOTAMs. Operators must also check appropriate GPS RAIM availability in areas where SBAS signal is unavailable.

b) **General operating procedures**

- 1) The pilot should comply with any instructions or procedures the manufacturer of the aircraft or avionics identifies as necessary to comply with the RNP 2 performance requirements. Pilots must adhere to any AFM limitations or operating procedures required by the manufacturer to maintain RNP 2 performance.
- 2) Operators and pilots should not request or file for RNP 2 routes unless they satisfy all the criteria in the relevant State documents. If an aircraft does not meet these criteria and receives a clearance from ATC to operate on an RNP 2 route, the pilot must advise ATC that they are unable to accept the clearance and must request an alternate clearance.
- 3) At system initialization, pilots must confirm the navigation database is current and verify proper aircraft position. Pilots must also verify proper entry of their ATC assigned route upon initial clearance and any subsequent change of route. Pilots must then ensure that the waypoint sequence depicted by the navigation system matches the route depicted on the appropriate charts and assigned route.

Note.- Pilots may notice a slight difference between the navigation information portrayed on the chart and their primary navigation display. Differences of 3 degrees or less may result from the equipment manufacturer's application of magnetic variation and are operationally acceptable.

- 4) Pilots must not fly a published RNP 2 route unless they can retrieve the route by name from the on-board navigation database and confirm it matches the charted route. However, pilots may subsequently modify the route through the insertion or deletion of specific waypoints in response to ATC requests and clearances. Pilots must not make manual entries or create new waypoints by manual entry of latitude and longitude or rho/theta values for fixed, published routes. Additionally, pilots must not change any route database waypoint type from a fly-by to a fly-over or vice versa. For flexible route structures, entry of latitude and longitude may also be permitted provided the potential for entry error by pilots is accounted for during associated safety analyses.

Note.- When the waypoints that make up an RNP 2 route are available by name in the aircraft's on-board navigation database, the operational authority may permit pilots to make a manual entry of the waypoints to define a published RNP 2 route in their navigation system.

- 5) The pilot need not cross-check the lateral navigation guidance with conventional NAVAIDs, as the absence of an integrity alert is sufficient to meet the integrity requirements.
- 6) For RNP 2 routes, pilots must use a lateral deviation indicator, flight director, or autopilot in lateral navigation mode. Pilots of aircraft with a lateral deviation display must ensure that the lateral deviation scaling is suitable for the navigation accuracy associated with the route (e.g. full-scale deflection: ± 2 NM for RNP 2 or ± 5 NM in the case of some TSO-C129a equipment) and know their allowable lateral deviation limits.

Note.- An appropriately scaled map display, as provided for in 2.3.3.6 a), may also be used.

- 7) All pilots must maintain a centre line, as depicted by on-board lateral deviation indicators and/or flight guidance during all RNP 2 operations described in this manual, unless authorized to deviate by ATC or under emergency conditions. For normal operations, cross-track error/deviation (the difference between the system computed path and the aircraft position relative to the path, i.e. FTE) should be limited to $\pm 1/2$ the navigation

accuracy associated with the route (i.e. 1 NM for RNP 2). Brief deviations from this standard (e.g. overshoots or undershoots) during and immediately after turns, up to a maximum of one times the navigation accuracy (i.e. 2 NM for RNP 2) are allowable. Some aircraft do not display or compute a path during turns, therefore, pilots of these aircraft may not be able to confirm adherence to the $\pm 1/2$ lateral navigation accuracy during turns, but must satisfy the standard during intercepts following turns and on straight segments.

- 8) Manually selecting or use of default aircraft bank limiting functions may reduce the aircraft's ability to maintain desired track and the pilot should not use these functions. Pilots should understand manually selecting aircraft bank-limiting functions may reduce their ability to satisfy ATC path expectations, especially when executing large angle turns. However, pilots should not deviate from AFM procedures and should limit the use of such functions within accepted procedures that meet the requirements for operation on an RNP 2 route.
 - 9) If ATC issues a heading assignment that takes an aircraft off a route, the pilot should not modify the flight plan in the RNP system until they receive a clearance to rejoin the route or the controller confirms a new route clearance. When the aircraft is not on the RNP 2 route, the RNP 2 performance requirements do not apply.
 - 10) Pilots of aircraft with RNP input selection capability should select a navigation accuracy value of 2 NM, or lower. The selection of the navigation accuracy value should ensure the RNP system offers appropriate lateral deviation scaling permitting the pilot to monitor lateral deviation and meet the requirements of the RNP 2 operation.
- c) **Contingency procedures**
- 1) The pilot must notify ATC of any loss of the RNP 2 capability (integrity alerts or loss of navigation). If unable to comply with the requirements of an RNP 2 route for any reason, pilots must advise ATC as soon as possible. The loss of RNP 2 capability includes any failure or event causing the aircraft to no longer satisfy the RNP 2 requirements.
 - 2) In the event of communications failure, the pilot should continue with the published lost communications procedure.

11. TRAINING PROGRAMMES

11.1 The training programme for flight crews and flight dispatchers (DV) shall provide sufficient training (e.g. using flight training devices, flight simulators or aircraft) on the aircraft's RNP system to the extent necessary. The training programme will include the following topics:

- a) the information of this AC;
- b) the meaning and proper use of aircraft equipment/navigation suffixes;
- c) route and airspace characteristics as determined from chart depiction and textual description;
- d) required navigation equipment on RNP 2 operations;
- e) RNP system-specific information:
 - 1) levels of automation, mode annunciations, changes, alerts, interactions, reversions, and degradation;
 - 2) functional integration with other aircraft systems;
 - 3) the meaning and appropriateness of route discontinuities as well as related flight crew procedures;
 - 4) pilot procedures consistent with the operation;
 - 5) types of navigation sensors utilized by the RNP system and associated system prioritization/weighting/logic/limitations;
 - 6) turn anticipation with consideration to speed and altitude affects;

- 7) interpretation of electronic displays and symbols use to conduct an RNP 2 operation; and
 - 8) understanding of the aircraft configuration and operational conditions required to support RNP 2 operations, e. g. appropriate selection of CDI scaling (lateral deviation display scaling);
- f) RNP system operating procedures, as applicable, including how to perform the following actions:
- 1) verify currency and integrity of aircraft navigation data;
 - 2) verify the successful completion of RNP system self-tests;
 - 3) initialize navigation system position;
 - 4) retrieve/manually enter and fly an RNP 2 route;
 - 5) verify waypoints and flight plan programming;
 - 6) fly direct to a WPT;
 - 7) fly a course/track to a WPT;
 - 8) intercept a course/track (flying assigned vectors and rejoining an RNP 2 route from "heading" mode);
 - 9) determine cross-track error/deviation. More specifically, the maximum deviations allowed to support RNP 2 must be understood and respected;
 - 10) resolve route discontinuities (insert and delete/eliminate en-route discontinuities);
 - 11) remove or reselect navigation sensor input; and
 - 12) perform parallel offset function during RNP 2 operations if capability exists. Pilots should know how offsets are applied, the functionality of their particular RNP system, and the need to advise ATC if this functionality is not available;
- g) operator-recommended levels of automation for phase of flight and workload, including methods to minimize cross-track error to maintain route centre line;
- h) radiotelephony phraseology for RNP applications; and
- i) contingency procedures for RNP failures.

12. NAVIGATION DATABASE

- a) Navigation data management is addressed in Annex 6, Part 1, Chapter 7. In support of this, the operator must obtain the navigation database from a supplier complying with RTCA DO 200A/EUROCAE document ED 76, Standards for Processing Aeronautical Data, and the database must be compatible with the intended function of the equipment. Regulatory authorities recognize compliance to the referenced standard using a LOA or other equivalent document.
- b) The operator must report any discrepancies invalidating an ATS route to the navigation database supplier, and the operator must take actions to prohibit their pilots from flying the affected ATS route.
- c) Aircraft operators should consider the need to conduct periodic checks of the operational navigation databases in order to meet existing quality system requirements.

13. OVERSIGHT, INVESTIGATION OF NAVIGATION ERRORS, AND WITHDRAWAL OF RNP 2 APPROVAL

- a) The operator will establish a process to receive, analyse, and follow up on navigation errors reports in order to determine appropriate corrective action.

- b) Information indicating the potential for repeated errors may require modification of an operator's training programme.
- c) Information attributing multiple errors to particular pilots may necessitate remedial training or license review.
- d) Repeated navigation error occurrences attributed to specific navigation equipment should result in cancellation of the operational approval permitting use of that equipment during RNP 2 operations.

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APPENDIX 1

FUNCTIONAL REQUIREMENTS

The following navigation displays and functions installed per AC 20-130A, AC 20-138() or equivalent airworthiness installation advisory material are required.

Paragraph	Functional requirements	Explanation
a)	Navigation data, including a failure indicator, must be displayed on a lateral deviation display (CDI, EHSI) and/or a navigation map display. These must be used as primary flight instruments for the navigation of the aircraft, for manoeuvre anticipation and for failure / status / integrity indication.	<p>1) Non-numeric lateral deviation display (e.g. CDI, EHSI), a failure annunciation, for use as primary flight instruments for navigation of the aircraft, for manoeuvre anticipation, and for failure / status / integrity indication, with the following six attributes:</p> <ul style="list-style-type: none"> (a) The capability to continuously display to the pilot flying, on the primary flight instruments for navigation of the aircraft (primary navigation display), the computed path and aircraft position relative to the path. For operations where the required minimum flight crew is two pilots, the means for the pilot not flying to verify the desired path and the aircraft position relative to the path must also be provided; (b) Each display must be visible to the pilot and located in the primary field of view ($\pm 15^\circ$ from the pilot's normal line of sight) when looking forward along the flight path; (c) The lateral deviation display scaling should agree with any implemented alerting and annunciation limits; (d) The lateral deviation display must also have a full-scale deflection suitable for the current phase of flight and must be based on the required track-keeping accuracy; (e) The display scaling may be set automatically by default logic, automatically to a value obtained from a navigation database, or manually by flight crew procedures. The full-scale deflection value must be known or must be available for display to the pilot commensurate with the required track-keeping accuracy; and (f) The lateral deviation display must be automatically slaved to the computed path. The course selector of the deviation display should be automatically slewed to the computed path or the pilot must adjust the CDI or HSI selected course to the computed

Paragraph	Functional requirements	Explanation
		<p>desired track.</p> <p>As an alternate means of compliance, a navigation map display can provide equivalent functionality to a lateral deviation display as described in Paragraphs (a) to (f) above, with appropriate map scales and giving equivalent functionality to a lateral deviation display. The map scale should be set manually to a value appropriate for the RNP 2 operation.</p>
b)	The RNP 2 operation requires the following minimum system and equipment functions:	<ol style="list-style-type: none"> 1) A navigation database, containing current navigation data officially promulgated for civil aviation, which can be updated in accordance with the AIRAC cycle and from which RNP 2 routes can be retrieved and loaded into the RNP system. The stored resolution of the data must be sufficient to achieve negligible PDE. Database protections must prevent pilot modification of the on-board stored data; 2) A means to display the validity period of the navigation data to the pilot; 3) A means to retrieve and display data stored in the navigation database relating to individual waypoints and NAVAIDs (when applicable), to enable the pilot to verify the RNP 2 route to be flown; and 4) For RNP 2 tracks in oceanic/remote continental airspace using flexible (e.g. organized) tracks, a means to enter the unique waypoints required to build a track assigned by the ATS provider.
c)	The means to display the following items, either in the pilot's primary field of view, or on a readily accessible display:	<ol style="list-style-type: none"> 1) The active navigation sensor type; 2) The identification of the active (To) waypoint; 3) The groundspeed or time to the active (To) waypoint; and 4) The distance and bearing to the active (To) waypoint.
d)	The capability to execute a "direct to" function.	The aircraft and avionics manufacturers should identify any limitations associated with conducting the "direct to" function during RNP 2 operations in the manufacturer's documentation.
e)	The capability for automatic leg sequencing with the display of sequencing to the pilot.	
f)	The capability to automatically execute waypoint transitions and	

Paragraph	Functional requirements	Explanation
	maintain track consistent with the RNP 2 performance requirements.	
g)	The capability to display an indication of RNP 2 system failure in the pilot's primary field of view.	
h)	Parallel offset function (optional)	<p>If implemented:</p> <ol style="list-style-type: none"> 1) The system must have the capability to fly parallel tracks at a selected offset distance; 2) When executing a parallel offset, the navigation accuracy and all performance requirements of the original route in the active flight plan apply to the offset route; 3) The system must provide for entry of offset distances in increments of 1 NM, left or right of course; 4) The system must be capable of offsets of at least 20 NM; 5) When in use, the system must clearly annunciate the operation of offset mode; 6) When in offset mode, the system must provide reference parameters (e.g. cross-track deviation, distance-to-go, time-to-go) relative to the offset path and offset reference points; 7) The system must annunciate the upcoming end of the offset path and allow sufficient time for the aircraft to return to the original flight plan path; and 8) Once the pilot activates a parallel offset, the offset must remain active for all flight plan route segments until the system deletes the offset automatically; the pilot enters a new direct-to routing, or the pilot manually cancels the offset.

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APPENDIX 2

NAVIGATION DATA VALIDATION PROGRAMME

1. INTRODUCTION

The information stored in the navigation database defines the lateral and longitudinal guidance of the aircraft for RNP 2 operations. Navigation database updates are carried out every 28 days. The navigation data used in each update are critical to the integrity of every RNP 2 route. This appendix provides guidance on operator procedures to validate the navigation data associated with the RNP 2 operations.

2. DATA PROCESSING

- a) The operator will identify in its procedures the person responsible for the navigation data updating process.
- b) The operator must document a process for accepting, verifying, and loading navigation data into the aircraft.
- c) The operator must place its documented data process under configuration control.

3. INITIAL DATA VALIDATION

3.1 The operator must validate every RNP 2 route flying under instrument meteorological conditions (IMC) to ensure compatibility with the aircraft and to ensure that the resulting paths are consistent with the published routes. As a minimum, the operator must:

- a) compare the navigation data of RNP 2 routes to be loaded into the FMS with valid charts and maps containing the published routes.
- b) validate the navigation data loaded for RNP 2 routes, either on the flight simulator or on the aircraft, under visual meteorological conditions (VMC). RNP 2 routes outlined on a map display must be compared to the published routes. Complete RNP 2 must be flown in order to ensure that the paths can be used, that they have no apparent lateral or longitudinal discrepancies, and that they are consistent with the published routes shown in the charts.
- c) Once the RNP 2 routes are validated, a copy of the validated navigation data shall be kept and maintained in order to compare them with subsequent data updates.

4. DATA UPDATING

Upon receiving a navigation data update and before using such data on the aircraft, the operator must compare the update with the validated routes. This comparison must identify and resolve any discrepancy in the navigation data. If there are significant changes (any change affecting the path or the performance of the route) in any part of the route, and if those changes are verified through the initial data, the operator must validate the amended route in accordance with the initial validation data.

5. NAVIGATION DATA SUPPLIERS

Navigation data suppliers must have a letter of acceptance (LOA) in order to process these data (e.g., FAA AC 20-153 or the document on the conditions for the issuance of letters of acceptance to navigation data suppliers by the European Aviation Safety Agency – EASA (EASA IR 21 Subpart G) or equivalent documents). A LOA recognises the data supplier as one whose data quality, integrity and quality management practices are consistent with the criteria of DO-200A/ED-

76. The database supplier of an operator must have a Type 2 LOA and its respective suppliers must have a Type 1 or 2 LOA. The CAA may accept a LOA issued to navigation data suppliers or issue its own LOA.

6. AIRCRAFT MODIFICATIONS (DATABASE UPDATE)

If an aircraft system necessary for RNP 2 operations is modified (e.g., change of software), the operator is responsible for validating the RNP 2 routes with the navigation database and the modified system. This can be done without any direct assessment if the manufacturer confirms that the modification has no effect on the navigation database or on path calculation. If there is no such confirmation by the manufacturer, the operator must perform an initial validation of the navigation data with the modified system.

APPENDIX 3**RNP 2 APPROVAL PROCESS**

- a) The RNP 2 approval process consists of two types of approvals, airworthiness and operational. Although the two have different requirements, they must be considered in one single process.
- b) This process is an orderly method used by the CAA to make sure that the applicants meet the established requirements.
- c) The approval process is made up by the following phases:
 - 1) Phase one: Pre-application
 - 2) Phase two: Formal application
 - 3) Phase three: Documentation evaluation
 - 4) Phase four: Inspection and demonstration
 - 5) Phase five: Approval
- d) In *Phase one - Pre-application*, the CAA calls the applicant or operator to a pre-application meeting. At this meeting, the CAA informs the applicant or operator of all the operational and airworthiness requirements that it must meet during the approval process, including the following:
 - 1) the contents of the formal application;
 - 2) the review and evaluation of the application by the CAA;
 - 3) the limitations (if any) applicable to the approval; and
 - 4) conditions under which the RNP 2 approval could be cancelled.
- e) In *Phase two – Formal Application*, the applicant or operator submits the formal application along with all the relevant documentation, as established in Paragraph 9.1.1 b) of this AC.
- f) In Phase three – *Documentation evaluation*, the CAA evaluates all the documentation and the navigation system to determine their eligibility and the approval method to be followed in connection with the aircraft. As a result of this analysis and evaluation, the CAA may accept or reject the formal application along with the documentation.
- g) In *Phase four – Inspection and demonstration*, the operator will provide training to its personnel and will carry out the validation flight, if required.
- h) In *Phase five - Approval*, the CAA issues the RNP 2 approval once the operator has met the airworthiness and operational requirements. For LAR 121 and 135 operators, the CAA will issue the OpSpecs, and for LAR 91 operators, a LOA.

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APPENDIX 4

FIXED RADIUS TRANSITION (FRT)

1. INTRODUCTION

1.1 Background

1.1.1 The FRT is intended to define transitions along airways in the case where separation between parallel routes is also required in the transition, and the fly-by transition is not compatible with the separation criteria.

1.1.2 Increasing demand on intense airspace use and the need to progress horizontal airspace availability in areas with high traffic density requires the design of new airspace structures with closer spaced routes. In a lot of instances, turns will be required in the route network, for example, to circumnavigate reserved airspace, transit from one airway structure to another or to connect en-route airspace to terminal airspace. Therefore, reduced route spacing will only be possible if similar route spacing can be maintained in the turns. Initial applications are expected to be based on the route designator conventions stipulated in Annex 11.

1.2 Purpose

The purpose of this appendix is to define the FRT navigation functionality, which is an enabler for applying closer route spacing along turns in the en-route network. This appendix may be associated with the following en-route RNP specifications: RNP 4, RNP 2 and A-RNP.

2. IMPLEMENTATION CONSIDERATIONS

2.1 Turn geometry

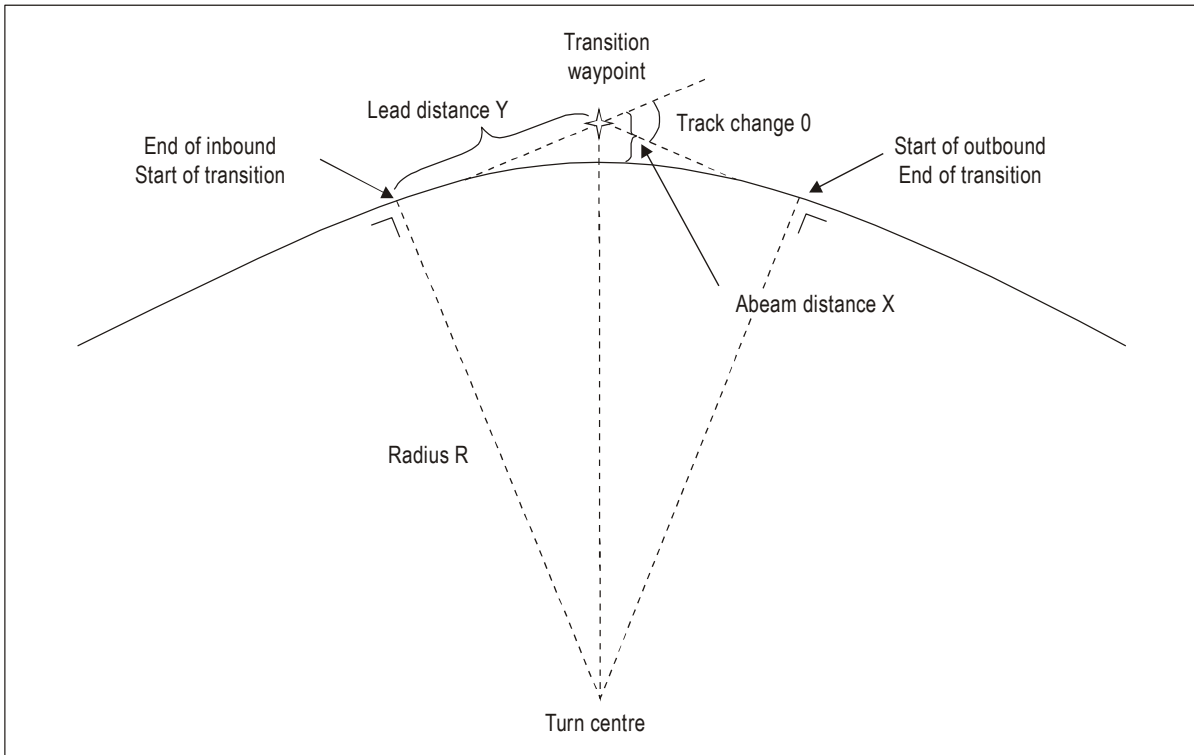
The geometry of the FRT is defined by the track change, θ (difference between outbound and inbound track in degrees), and the radius, R (see Figure 4 -1). Those two parameters define the turn centre, the lead distance Y , which is the distance from turn initiation towards the transition waypoint, and the abeam distance X , which is the distance between the transition waypoint and the point where the aircraft crosses the bisector of the turn. The latter two values are determined by the following expressions:

$$Y = R \tan(\theta/2)$$

$$X = R \left(\frac{1}{\cos(\theta/2)} - 1 \right)$$

2.2 Aircraft bank angle

The FRT will result in a bank angle dependent upon ground speed. Therefore, during the turn, changes to airspeed and wind will result in varying bank angle. The turn radius must be selected to ensure that the bank angle remains within acceptable limits for cruise operations.

Figure 4-1 - Fixed radius transition

2.3 Application of FRT

2.3.1 The FRT should be used when there is a requirement for a specific fixed radius curved path en route. The radius is calculated, and the curved path is seamlessly joined with the associated route segments by the RNP system. RNP systems supporting this path transition provide the same ability to conform to the track-keeping accuracy during the turn as in the straight line segments. FRTs are expected to be applied where accurate repeatable and predictable navigation performance is required for what is, in effect, a constant radius fly-by turn.

2.3.2 The FRT may be associated as an optional requirement for routes defined using the following RNP navigation specification:

- RNP 4;
- RNP 2; and
- Advanced RNP (A-RNP)

2.4 Route design considerations and assumptions

2.4.1 The radius of turn should be either 22.5 NM to be used on upper routes (e.g. FL 200 and above) or 15 NM to be used on lower routes (e.g. FL190 and below). The selected radius should be published for the appropriate waypoint(s) in the AIP for the route. Other radius of turn values can be considered, but must be evaluated against the bounds of aircraft performance.

2.4.2 The inbound and outbound route segments will be tangential to the FRT as computed by the navigation system.

2.4.3 FRTs will not be constructed by the RNP system where the track change is greater than 90 degrees.

2.4.4 For FRTs where the next flight path segment requires a different navigation accuracy, the navigation accuracy applicable to the complete FRT must be the largest one. For example, when a transition occurs from a path segment requiring an accuracy of 1.0 NM to a path segment requiring an accuracy of 2.0 NM, the navigation accuracy of 2.0 NM must apply throughout the FRT.

2.4.5 Where there is a transition from one airway to another airway, both requiring an FRT at the common transition waypoint, the larger of the two radii applicable to the common transition waypoint shall be selected.

3. AIRCRAFT REQUIREMENTS

3.1 Functional requirements

The system must be able to define transitions between flight path segments using a three-digit numeric value for the radius of turn (to 1 decimal place) in nautical miles, e.g. 15.0, 22.5.

3.2 On-board performance monitoring and alerting

3.2.1 The navigation system must have the capability to execute a flight path transition and maintain a track consistent with a fixed radius between two route segments. The lateral TSE must be within $\pm 1 \times$ RNP of the path defined by the published procedure for at least 95 per cent of the total flight time for each phase of flight and any manual, autopilot and/or flight director mode. For path transitions where the next route segment requires a different TSE and the path transition required is an FRT, the navigation system may retain the navigation accuracy value for the previous route segment throughout the entire FRT segment. For example, when a transition occurs from a route segment requiring an accuracy value of 2.0 to a route segment requiring an accuracy value of 1.0, the navigation system may use an accuracy value of 2.0 throughout the FRT.

Note.- Default values for FTE can be found in RTCA DO-283A. FAA AC 120-29A, 5.19.2.2 and 5.19.3.1, also provides guidance on establishing FTE values.

3.3 Display requirements

3.3.1 The aircraft system shall provide means for the flight crew to monitor the FTE during the FRT.

3.3.2 FTE monitoring shall be provided by means of displaying the curved path of the FRT on a moving map display (navigation display) with pilot selectable range and numerical indication of the cross-track value.

3.4 Navigation database

The navigation database will specify the radius associated with a particular fix, along an airway.

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RNP 2 JOB AID

REQUEST TO CONDUCT RNP 2 OPERATIONS

1. Introduction

This Job Aid was developed by the Latin American Regional Safety Oversight Cooperation System (SRVSOP) to provide States, operators, and inspectors with guidance on the process to be followed by an operator in order to obtain a RNP 2 authorization.

2. Purpose of the Job Aid

- 2.1 To give operators and inspectors information on the main reference documents of RNP 2.
- 2.2 To provide tables showing the contents of the application, the associated reference paragraphs, the place in the application of the operator where RNP 2 elements are mentioned and columns for inspector comments and follow-up on the status of various elements of RNP 2.

3. Actions recommended for the inspector and operator

Some recommendations for use of the Job Aid follow:

- 3.1 At the pre-application meeting with the operator, the inspector reviews the “basic events of the RNP 2 approval process” described in Part 1 of this Job Aid, in order to provide an overview of the approval process events.
- 3.2 The inspector reviews this Job Aid with the operator in order to establish the form and content of the RNP 2 approval application.
- 3.3 The operator uses this Job Aid as a guide to collect the documents/annexes of the RNP 2 application.
- 3.4 The operator inserts in the Job Aid references showing in what part of its documents are the RNP 2 programme elements located.
- 3.5 The operator submits the Job Aid and the application to the inspector (documents/annexes).
- 3.6 The inspector indicates in the Job Aid whether an item is in compliance or needs corrective action.
- 3.7 The inspector informs the operator as soon as possible when a corrective action by the operator is required.
- 3.8 The operator provides the inspector with the revised material when so requested.
- 3.9 The CAA provides the operator with the operational specifications (OpSpecs) or a letter of authorisation (LOA), as applicable, when the tasks and documents have been completed.

4. **Structure of the Job Aid**

Parts	Topics	Page
Part 1	General information	3
Part 2	Information on aircraft and operator identification	5
Part 3	Operator application (Annexes and documents)	7
Part 4	Contents of the operator application for RNP 2	9
Part 5	Guide to determine the eligibility of RNP 2 aircraft	13
Part 6	Basic pilot procedures for RNP 2 operations	17

5. **Main sources of documents, information, and contacts**

To access the RNP 2 Job Aid, enter to the Web page of the ICAO/SAM Regional Office (www.lima.icao.int) under the SRVSOP link or directly to the following address: <http://www1.lima.icao.int/srvsop/document>

6. **Main reference documents**

Reference Document	Title
Annex 6	Operation of aircraft
ICAO Doc 9613	Performance based navigation (PBN) manual
AMC 20-5	Acceptable means of compliance for airworthiness approval and operational criteria for the use of the NAVSTAR Global positioning system (GPS)
AC 20-130A	Airworthiness approval of navigation or flight management systems integrating multiple navigation sensors
AC 20-138A	Airworthiness approval of global navigation satellite system (GNSS) equipment
TSO-C115b	Airborne area navigation equipment using multi-sensor inputs
TSO-C129a	Airborne supplemental navigation equipment using the global positioning system (GPS)
TSO-C145a	Airborne navigation sensors using the global positioning system (GPS) augmented by the wide area augmentation system (WAAS)
TSO-C146a	Stand-Alone airborne navigation equipment using the global positioning system (GPS) augmented by the wide area augmentation system (WAAS)

PART 1: GENERAL INFORMATION

Basic events in the RNP 2 approval process

	Action by the operator	Action by the CAA
1	Establishes the need to obtain RNP 2 authorization.	
2	Reviews the AFM, AFM supplement or Type certificate data sheet (TCDS), or other appropriate documents [e.g., service bulletins (SB), service letters (SL), etc.] to determine the eligibility of the aircraft for RNP 2 operations. The operator contacts the aircraft or avionics manufacturer, if necessary, to confirm RNP 2 or higher eligibility of the aircraft.	
3	Contacts the CAA to schedule a pre-application meeting to discuss the operational approval requirements.	
4		During the pre-application meeting, establishes: <ul style="list-style-type: none"> • the form and contents of the application; • the documents that support RNP 2 approval • the date in which the application will be submitted for evaluation • the need to conduct a validation flight observed by the CAA.
5	Submits the application at least 60 days before start-up of RNP 2 operations.	
6		Reviews the request of the operator.
7	Once the amended manuals, programmes, and documents have been approved, provides training to flight crews, flight dispatchers, and maintenance personnel, and conducts a validation flight, if required by the CAA.	Only if required, participates in the validation flight.
8		Once the operational and airworthiness requirements have been met, issues the operational approval in the form of OpSpecs for LAR 121 or 135 operators or equivalent operators, or an LOA for LAR 91 operators or equivalent operators, as appropriate.

Notes related to the approval process**1. Responsible authority**

- a. **Commercial air transport (LAR 121 and/or 135 regulations or equivalent).**- The **State of registry** determines that the aircraft meets the airworthiness requirements. The **State of the operator** issues the RNP 2 approval (*e.g.*, OpSpecs).
- b. **General aviation (LAR 91 regulations or equivalent).**- The **State of registry** determines that the aircraft meets the airworthiness requirements and issues the operational approval (*e.g.*, an LOA).

2. The CAA does not need to issue a LOA or equivalent document for each individual area of operation in the case of LAR 91 operators.

3. LAR 121 and/or 135 operators with RNP 2 approval must list this approval in the OpSpecs.

4. Related sections of the Latin American Aeronautical Regulations (LAR) or equivalent regulations

- a. LAR 91 Sections 91.1015 and 91.1640 or equivalents
- b. LAR 121 Section 121.995 (b) or equivalent
- c. LAR 135 Section 135.565 (c) or equivalent

5. Related ICAO Documents

- a. Annex 6 to the Convention on International Civil Aviation – Operation of Aircraft
- b. Annex 10 to the Convention on International Civil Aviation – Aeronautical telecommunications
- c. Annex 15 to the Convention on International Civil Aviation – Aeronautical information services
- d. ICAO Doc 9613 – Performance-based navigation (PBN) manual
- e. ICAO Doc 4444 – Procedures for air navigation services – Air traffic management

PART 2: INFORMATION ON THE IDENTIFICATION OF AIRCRAFT AND OPERATORS

NAME OF THE OPERATOR: _____

Aircraft manufacturer, model, and series	Registration numbers	Serial numbers	RNP 2 system Number, manufacturer, and model	RNP specification

DATE OF PRE-APPLICATION MEETING _____

DATE ON WHICH THE APPLICATION WAS RECEIVED _____

DATE ON WHICH THE OPERATOR INTENDS TO BEGIN RNP 2 OPERATIONS _____

IS THE CAA NOTIFICATION DATE APPROPRIATE? YES ____ NO ____

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PART 3 – OPERATOR APPLICATION (ANNEXES AND DOCUMENTS)

Annex	Title of Annex/Document	Indication of inclusion by the operator	Comments by the Inspector
A	Operator letter requesting RNP 2 authorization		
B	<p>Airworthiness documents showing aircraft eligibility for RNP 2.</p> <p>AFM, AFM revision, AFM supplement, or Type certificate data sheet (TCDS) showing RNP system eligibility for RNP 2 or less.</p> <p>Statement by the manufacturer.- Aircraft that have a statement by the manufacturer documenting compliance with SRVSOP CA 91-005 criteria or equivalent, meet the performance and functional requirements of said document.</p>		
C	<p>Aircraft modified to meet RNP 2 standards. Documentation on aircraft inspection and/or modification, if applicable. Maintenance records documenting the installation or modification of aircraft systems (e.g., FAA Form 337 – major repairs and alterations).</p>		
D	<p>Maintenance programme</p> <ul style="list-style-type: none"> • For aircraft with established RNP 2 system maintenance practices, the list of references of the document or programme. • For recently installed RNP 2 systems, the maintenance practices for their review. 		
E	<p>Minimum equipment list (MEL) (only for operators conducting operations based on a MEL):</p> <p>MEL showing provisions for RNP 2 systems.</p>		
F	<p>Training</p> <p>1. LAR 91 operators or equivalent: Training method: Training at home, LAR 142 training centres, or other training courses, course</p>		

Annex	Title of Annex/Document	Indication of inclusion by the operator	Comments by the Inspector
	<p>completion records.</p> <p>2. LAR 121 and/or 135 operators or equivalent: Training programmes (training curricula) for flight crews, flight dispatchers, and maintenance personnel.</p>		
G	<p>Operating policies and procedures</p> <p>1. LAR 91 operators or equivalent: Operations manual (OM) or sections to be attached to the application, corresponding to RNP 2 operating procedures and policies.</p> <p>2. LAR 121 and/or 135 operators or equivalent: Operations manual and checklists.</p>		
H	<p>Navigation database</p> <p>Details of the navigation data validation programme.</p>		
I	<p>Withdrawal of RNP 2 approval</p> <p>Indication of the need to follow up on navigation error reports submitted and the possibility of withdrawal of RNP 2 approval.</p>		
J	<p>Validation flight plan: Only if required by the CAA.</p>		

CONTENTS OF THE APPLICATION TO BE SUBMITTED BY THE OPERATOR

___ **RNP 2 COMPLIANCE DOCUMENTATION OF THE AIRCRAFT/NAVIGATION SYSTEMS**

___ **OPERATING PROCEDURES AND POLICIES**

___ **SECTIONS OF THE MAINTENANCE MANUAL RELATED TO THE RNP 2 SYSTEM (if not previously reviewed)**

Note 1: Documents may be grouped in a single folder or may be sent as individual documents.

PART 4: CONTENTS OF THE OPERATOR APPLICATION FOR RNP 2 OPERATIONS

#	Contents of the RNP 2 application by the operator	Reference paragraphs CA 91-005	In what Annexes/Documents of the operator can the application contents be located (e.g. Annex A)	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	Operator request letter Statement of intent to obtain RNP 2 authorization.				
2	Description of aircraft equipment.				
3	Eligibility of RNP 2 systems. Airworthiness documents establishing the eligibility of the RNP 2 navigation system, its approval status, and a list of the aircraft for which the approval is being requested.				
4	Training programme 1. LAR 121 or 135 operators or equivalent: Training programmes: Operators will develop an initial and periodic training programme for flight crews, flight dispatchers, if applicable, and maintenance personnel. 2. LAR 91 operators or equivalent: Training methods: The following methods are acceptable for these operators: Training at home, LAR 142 training centres, or other training courses.				

#	Contents of the RNP 2 application by the operator	Reference paragraphs CA 91-005	In what Annexes/Documents of the operator can the application contents be located (e.g. Annex A)	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
5	<p>Operating procedures</p> <p>1. LAR 121 and/or 135 operators or equivalent: Operations manual and checklists.</p> <p>2. LAR 91 operators or equivalent: Operations manual or section of the operator application documenting RNP 2 policies and procedures.</p>				
6	<p>Maintenance practices</p> <ul style="list-style-type: none"> • For aircraft with established maintenance practices for RNP 2 navigation systems, the operator will provide document references. • For newly installed RNP 2 systems, the operator will provide maintenance practices for their review. 				
7	<p>Update of the minimum equipment list (MEL)</p> <p>Applicable to operators conducting operations according to a MEL.</p>				
8	<p>Navigation data validation programme</p>				
9	<p>Withdrawal of RNP 2 approval</p> <p>Indication of the need for follow-up on the navigation error reports and the possibility</p>				

#	Contents of the RNP 2 application by the operator	Reference paragraphs CA 91-005	In what Annexes/Documents of the operator can the application contents be located (e.g. Annex A)	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	of withdrawal of the RNP 2 approval.				
10	Validation flight plan, only if required The validation flight plan will be presented only if required.				

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PART 5 – GUIDE TO DETERMINE THE ELIGIBILITY OF RNP 2 AIRCRAFT

#	Topics	Reference paragraphs CA 91-005	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	Aircraft eligibility requirements for RNP 2 operations General				
1a	RNP 2 navigation specification requires GNSS as the primary navigation sensor, either as a stand-alone navigation system or as part of a multi-sensor system.				
1b	RNP 2 operations in oceanic and remote airspace require dual independent long-range navigation system.				
1c	RNP 2 operations in continental en-route airspace may use a single GNSS, provided an alternate means of navigation is available and if required by the category of operation.				
2	On-board performance monitoring and alerting requirements				
	For RNP 2 operations on-board performance monitoring and alerting is required				
	The aircraft navigation system, or aircraft navigation system and pilot in combination, are required to monitor the TSE, and to				

#	Topics	Reference paragraphs CA 91-005	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	<p>provide an alert if the accuracy requirement is not met or if the probability that the lateral TSE exceeds two times the accuracy value is larger than 1×10^{-5}. To the extent operational procedures must be used to satisfy this requirement, the crew procedure, equipment characteristics and installation should be evaluated for their effectiveness and equivalence.</p> <p>The navigation system is not required to provide both performance and sensor-based alerts, e.g. if a TSE-based alert is provided, a GNSS alert may not be necessary.</p>				
3	System performance, control, and alerting				
	<p>Continuity.- For RNP 2 oceanic/remote continental airspace applications, loss of function is a major failure condition. For RNP 2 continental applications, loss of function is a minor failure condition if the operator can revert to a different navigation system and proceed to a suitable airport. If a single aircraft configuration is to support all potential applications of RNP 2, the more stringent continuity requirement applies. The AFM limitations section must reflect restrictions in capability to aid in operational approvals.</p>				

#	Topics	Reference paragraphs CA 91-005	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
4	<p>Aircraft eligibility requirements for RNP 2 operations.</p> <p>The aircraft is eligible for RNP 2 operations if:</p> <ol style="list-style-type: none"> 1. the AFM, an AFM supplement or OEM service letter states that the aircraft navigation system is approved for RNP 2 operations; or 2. the aircraft is equipped with GNSS stand-alone system using E/TSO-C129a Class A1 or A2 or E/TSO-C146 () Class Gamma and Operational Class 1, 2 or 3, installed for IFR use in accordance with FAA AC 20-138A or AC 20-138B; or 3. the aircraft is equipped with a multi-sensor system (e.g. FMS) with GNSS equipment using E/TSO-C129a sensor Class B or C or E/TSO-C145 () Class 1, 2 or 3. The GNSS system must be installed in accordance with AC 20-138A and the associated FMS must comply with E/TSO-C115b and AC 20-130A. 				
5	<p>Functional requirements – See Appendix 1 of this AC</p>				
6	<p>Maintenance requirements</p>				

#	Topics	Reference paragraphs CA 91-005	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
7	Navigation database Details of the navigation data validation programme				

PART 6 - BASIC PILOT PROCEDURES FOR RNP 2 OPERATIONS

Topics		Reference paragraphs CA 91-005	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
Operating procedures					
1	Pre-flight planning				
	Operators and pilots intending to conduct operations on RNP 2 routes must file the appropriate flight plan suffixes.				
	The on-board navigation data must be current and include appropriate procedures. Navigation databases should be current for the duration of the flight. If the AIRAC cycle is due to change during flight, operators and pilots should establish procedures to ensure the accuracy of the navigation data, including the suitability of navigation facilities defining the routes and procedures for flight.				
	The operator must confirm the availability of the NAVAID infrastructure, required for the intended routes, including those for use in a non-GNSS contingency, for the period of intended operations using all available information. Since Annex 10 requires GNSS integrity (RAIM or SBAS signal), the procedures should determine the availability of these services and functions as appropriate. For aircraft navigating with SBAS capability (all TSO-C145()/C146()), operators should check appropriate GNSS RAIM availability in areas				

Topics	Reference paragraphs CA 91-005	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
where the SBAS signal is unavailable.				
<p>1) RAIM (ABAS) availability</p> <p>(a) RAIM levels required for RNP 2 can be verified either through NOTAMs (where available) or through prediction services. Operators must be familiar with the prediction information available for the intended route.</p> <p>(b) For systems whose integrity is based on RAIM, RAIM prediction must be done before departure. This capability can be provided by a ground service or through the RAIM prediction capability of the aircraft on-board receiver.</p> <p>(c) The prediction of RAIM availability must take into account the last NOTAMs of the GPS constellation and the avionics model (if available). The RAIM prediction service can be provided through the ANSPs, the avionics manufacturers, other entities, or through the RAIM prediction capability of the aircraft on-board receiver. RAIM availability can be confirmed using a model-specific RAIM prediction software.</p> <p>(d) The predictive capability must account for known and predicted outages of GPS satellites or other effects on the navigation system sensors. The prediction programme should not use a mask angle below 5</p>				

Topics	Reference paragraphs CA 91-005	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
<p>degrees, since operational experience indicates that satellite signals on low elevations are not reliable. RAIM availability prediction should take into account the latest GPS constellation notices to airmen (NOTAMs) issued by the CAA or by the ANSPs, and use an identical algorithm to that used in the airborne equipment or an algorithm based on assumptions for RAIM prediction that provides a more conservative result.</p> <p>(e) In the event that a continuous loss of the appropriate failure detection level is forecast for more than five (5) minutes for any portion of the RNP 2 operation, the flight plan shall be revised (e.g., delaying the departure or planning a different departure procedure).</p> <p>(f) The RAIM availability prediction software does not guarantee the service. This software is rather a tool for assessing the expected capacity to meet the required navigation performance. Due to unplanned failures of some GNSS elements, pilots and ANSPs must understand that both RAIM and GNSS navigation can be lost while the aircraft is on flight, which may require reversal to an alternate means of navigation. Therefore, pilots must assess their navigation capabilities (potentially to an alternate aerodrome) in case of failure</p>				

	Topics	Reference paragraphs CA 91-005	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	<p>of GNSS navigation. If system integrity needs to be verified, the RAIM prediction programme shall meet the criteria of FAA AC 20-138, Paragraph 12.</p> <p>(g) For aircraft navigating with SBAS receivers (all E/TSO-C145/C146), operators must take into account the latest GPS constellation and SBAS NOTAMs. Operators must also check appropriate GPS RAIM availability in areas where SBAS signal is unavailable.</p>				
2	General operating procedures				
	<p>The pilot should comply with any instructions or procedures the manufacturer of the aircraft or avionics identifies as necessary to comply with the RNP 2 performance requirements. Pilots must adhere to any AFM limitations or operating procedures required by the manufacturer to maintain RNP 2 performance.</p>				
	<p>Operators and pilots should not request or file for RNP 2 routes unless they satisfy all the criteria in the relevant State documents. If an aircraft does not meet these criteria and receives a clearance from ATC to operate on an RNP 2 route, the pilot must advise ATC that they are unable to accept the clearance and must request an alternate clearance.</p>				

Topics	Reference paragraphs CA 91-005	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
<p>At system initialization, pilots must confirm the navigation database is current and verify proper aircraft position. Pilots must also verify proper entry of their ATC assigned route upon initial clearance and any subsequent change of route. Pilots must then ensure that the waypoint sequence depicted by their navigation system matches the route depicted on the appropriate chart(s) and their assigned route.</p> <p><i>Note.- Pilots may notice a slight difference between the navigation information portrayed on the chart and their primary navigation display. Differences of 3 degrees or less may result from the equipment manufacturer's application of magnetic variation and are operationally acceptable.</i></p>				
<p>Pilots must not fly a published RNP 2 route unless they can retrieve the route by name from the on-board navigation database and confirm it matches the charted route. However, pilots may subsequently modify the route through the insertion or deletion of specific waypoints in response to ATC requests and clearances. Pilots must not make manual entries or create new waypoints by manual entry of latitude and longitude or rho/theta values for fixed, published routes. Additionally, pilots must not change any route database waypoint type from a fly-by to a fly-over or vice versa. For flexible route structures, entry of latitude and longitude may also be permitted provided the potential for entry error by pilots is accounted for during associated safety analyses.</p> <p><i>Note.- When the waypoints that make up an RNP 2 route are</i></p>				

Topics	Reference paragraphs CA 91-005	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
<p><i>available by name in the aircraft's on-board navigation database, the operational authority may permit pilots to make a manual entry of the waypoints to define a published RNP 2 route in their navigation system.</i></p>				
<p>The pilot need not cross-check the lateral navigation guidance with conventional NAVAIDs, as the absence of an integrity alert is sufficient to meet the integrity requirements.</p>				
<p>For RNP 2 routes, pilots must use a lateral deviation indicator, flight director, or autopilot in lateral navigation mode. Pilots of aircraft with a lateral deviation display must ensure that the lateral deviation scaling is suitable for the navigation accuracy associated with the route (e.g. full-scale deflection: ± 2 NM for RNP 2 or ± 5 NM in the case of some TSO-C129a equipment) and know their allowable lateral deviation limits.</p> <p><i>Note.- An appropriately scaled map display, as provided for in 2.3.3.6 a), may also be used.</i></p>				
<p>All pilots must maintain a centre line, as depicted by on-board lateral deviation indicators and/or flight guidance during all RNP 2 operations described in this manual, unless authorized to deviate by ATC or under emergency conditions. For normal operations, cross-track error/deviation (the difference between the system computed path and the aircraft position relative to the path, i.e. FTE) should be limited to $\pm \frac{1}{2}$ the navigation accuracy associated with the route (i.e. 1 NM for RNP 2).</p>				

Topics	Reference paragraphs CA 91-005	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
<p>Brief deviations from this standard (e.g. overshoots or undershoots) during and immediately after turns, up to a maximum of one times the navigation accuracy (i.e. 2 NM for RNP 2) are allowable. Some aircraft do not display or compute a path during turns, therefore, pilots of these aircraft may not be able to confirm adherence to the $\pm\frac{1}{2}$ lateral navigation accuracy during turns, but must satisfy the standard during intercepts following turns and on straight segments.</p>				
<p>Manually selecting or use of default aircraft bank limiting functions may reduce the aircraft's ability to maintain desired track and the pilot should not use these functions. Pilots should understand manually selecting aircraft bank-limiting functions may reduce their ability to satisfy ATC path expectations, especially when executing large angle turns. However, pilots should not deviate from AFM procedures and should limit the use of such functions within accepted procedures that meet the requirements for operation on an RNP 2 route.</p>				
<p>If ATC issues a heading assignment that takes an aircraft off a route, the pilot should not modify the flight plan in the RNP system until they receive a clearance to rejoin the route or the controller confirms a new route clearance. When the aircraft is not on the RNP 2 route, the RNP 2 performance requirements do not apply.</p>				

	Topics	Reference paragraphs CA 91-005	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	Pilots of aircraft with RNP input selection capability should select a navigation accuracy value of 2 NM, or lower. The selection of the navigation accuracy value should ensure the RNP system offers appropriate lateral deviation scaling permitting the pilot to monitor lateral deviation and meet the requirements of the RNP 2 operation.				
6	Contingency procedures				
	The pilot must notify ATC of any loss of the RNP 2 capability (integrity alerts or loss of navigation). If unable to comply with the requirements of an RNP 2 route for any reason, pilots must advise ATC as soon as possible. The loss of RNP 2 capability includes any failure or event causing the aircraft to no longer satisfy the RNP 2 requirements.				
	In the event of a communication failure, the pilot should continue with the published lost communications procedure.				

SRVSOP contacts:

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Job Aid: RNP 2

Version: 1

Date: 16/09/2013

ADVISORY CIRCULAR

CA : **91-006**
DATE : **12/10/09**
REVISION : **Original**
ISSUED BY : **SRVSOP**

SUBJECT: AIRCRAFT AND OPERATOR APPROVAL FOR BASIC-RNP 1 OPERATIONS

1. PURPOSE

This Advisory Circular (AC) establishes Basic-RNP 1 approval requirements for aircraft and operators.

An operator may use alternate means of compliance, provided those means are acceptable to the Civil Aviation Administration (CAA).

The future tense of the verb or the term "shall" apply to operators who choose to meet the criteria set forth in this CA.

2. RELEVANT SECTIONS OF THE LATIN AMERICAN AERONAUTICAL REGULATIONS (LAR) OR EQUIVALENT

LAR 91: Sections 91.1015 and 91.1640 or equivalents

LAR 121: Section 121.995 (b) or equivalent

LAR 135: Section 135.565 (c) or equivalent

3. RELATED DOCUMENTS

Annex 6	Operation of aircraft Part I – International commercial air transport – Aeroplanes Part II – International general aviation - Aeroplanes
Annex 10	Aeronautical communications Volume I: Radio navigation aids
Annex 15	Aeronautical information services
ICAO Doc 9613	Performance based navigation (PBN) manual
ICAO Doc 4444	Procedures for air navigation services – Air traffic management (PANS-ATM)
ICAO Doc 8168	Aircraft operations Volume I: Flight procedures Volume II: Construction of visual and instrument flight procedures
FAA AC 90-105 Appendix 2	Qualification criteria for RNP 1 (terminal) operations

4. DEFINITIONS AND ABBREVIATIONS

4.1 Definitions

a) **Aircraft-based augmentation system (ABAS).**- A system which augments and/or integrates

the information obtained from the other GNSS elements with information available on board the aircraft. The most common form of ABAS is the receiver autonomous integrity monitoring (RAIM).

- b) **Area navigation (RNAV).**- A navigation method that allows aircraft to operate on any desired flight path within the coverage of ground- or space-based navigation aids, or within the limits of the capability of self-contained aids, or a combination of both methods.

Area navigation includes performance-based navigation as well as other operations that are not contemplated in the definition of performance-based navigation.

- c) **Flight technical error (FTE).**- The FTE is the accuracy with which an aircraft is controlled as measured by the indicated aircraft position with respect to the indicated command or desired position. It does not include blunder errors.
- d) **Global navigation satellite system (GNSS).**- A generic term used by the International Civil Aviation Organization (ICAO) to define any global position, speed, and time determination system that includes one or more main satellite constellations, such as GPS and the global navigation satellite system (GLONASS), aircraft receivers and several integrity monitoring systems, including aircraft-based augmentation systems (ABAS), satellite-based augmentation systems (SBAS), such as the wide area augmentation systems (WAAS), and ground-based augmentation systems (GBAS), such as the local area augmentation system (LAAS).

Distance information will be provided, at least in the immediate future, by GPS and GLONASS.

- e) **Global positioning system (GPS).**- The global positioning system (GNSS) of the United States is a satellite-based radio navigation system that uses precise distance measurements to determine the position, speed, and time in any part of the world. The GPS is made up by three elements: the spatial, the control, and the user elements. The GPS spatial segment nominally consists of, at least, 24 satellites in 6 orbital planes. The control element consists of 5 monitoring stations, 3 ground antennas, and one main control station. The user element consists of antennas and receivers that provide the user with position, speed, and precise time.
- f) **Navigation specifications.**- Set of aircraft and flight crew requirements needed to support performance-based navigation operations in a defined airspace. There are two kinds of navigation specifications:

Required Navigation Performance (RNP) Specification.- Area navigation specification that includes the performance control and alerting requirement, designated by the prefix RNP; e.g., RNP 4, RNP APCH, RNP AR APCH.

Area Navigation (RNAV) Specification.- Area navigation specification that does not include the performance control and alerting requirement, designated by the prefix RNAV; e.g., RNAV 5, RNAV 2, RNAV 1.

Note 1.- *The Manual on Performance-based Navigation (PBN) (Doc 9613), Volume II, contains detailed guidelines on navigation specifications.*

Note 2.- *The term RNP, formerly defined as "a statement of the navigation performance necessary for operation within a defined airspace", has been deleted from the Annexes to the Convention on International Civil Aviation because the RNP concept has been replaced by the PBN concept. In said Annexes, the term RNP is now only used within the context of the navigation specifications that require on-board performance control and alerting; e.g., RNP 4 refers to the aircraft and the operational requirements, including a lateral performance of 4 nautical miles (NM), with the requirement for on-board performance control and alerting as described in the PBN Manual of the International Civil Aviation Organization (ICAO) (Doc 9613).*

- g) **Navigation system error (NSE).**- The difference between the true position and the estimated position.
- h) **Path definition error (PDE).**- The difference between the defined path and the desired path at a given place and time.
- i) **Performance-based navigation (PBN).**- Performance-based area navigation requirements applicable to aircraft conducting operations on an ATS route, on an instrument approach

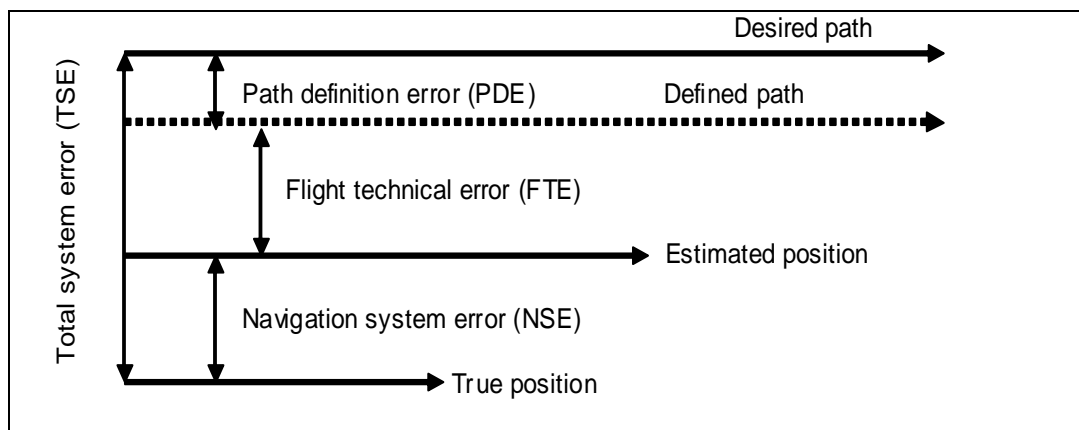
procedure, or in a designated airspace.

Performance requirements are expressed in navigation specifications (RNAV and RNP specifications) in terms of the precision, integrity, continuity, availability, and functionality necessary to perform the proposed operation within the context of a particular airspace concept.

- j) **Receiver autonomous integrity monitoring (RAIM).**- A technique used in a GPS receiver/processor to determine the integrity of its navigation signals, using only GPS signals or GPS signals enhanced with barometric altitude data. This determination is achieved by a consistency check between redundant pseudo-range measurements. At least one additional available satellite is required with respect to the number of satellites that are needed for the navigation solution.
- k) **RNP operations.**- Aircraft operations that use an RNP system for RNP applications.
- l) **RNP system.**- An area navigation system that supports on-board performance control and alerting.
- m) **Standard instrument arrival (STAR).**- A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an air traffic service (ATS) route, with a point from which a published instrument approach procedure can be commenced.
- n) **Standard instrument departure (SID).**- A designated instrument flight rule (IFR) departure route linking the aerodrome or a specified runway of the aerodrome with a specified significant point, normally on a designated ATS route, at which the en-route phase of a flight commences.
- o) **Total system error (TSE).**- The difference between the true position and the desired position. This error is equal to the sum of the vectors of the path definition error (PDE), the flight technical error (FTE), and the navigation system error (NSE).

Note.- On occasions, the FTE is known as path steering error (PSE), and the NSE as position estimation error (PEE).

Total system error (TSE)



- a) **Way-point (WPT).** A specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. Way-points are identified as either:
 - Fly-by way-point.*- A way-point which requires turn anticipation to allow tangential interception of the next segment of a route or procedure.
 - Fly over way-point.*- A way-point at which a turn is initiated in order to join the next segment of a route or procedure.

4.2 Abbreviations

- a) AAC Civil Aviation Administration/Civil Aviation Authority

b)	ABAS	Aircraft-based augmentation system
c)	AC	Advisory circular (FAA)
d)	AFM	Aircraft flight manual
e)	VM	Heading of the aircraft to a normal termination
f)	AIP	Aeronautical information publication
g)	AIRAC	Aeronautical information regulation and control
h)	ANSP	Air navigation service providers
i)	AP	Automatic pilot
j)	APV	Approach procedure with vertical guidance
k)	ARP	Aerodrome reference point
l)	ATC	Air traffic control
m)	ATM	Air traffic management
n)	ATS	Air traffic service
o)	baro-VNAV	Barometric vertical navigation
p)	CA	Advisory circular (SRVSOP)
q)	CA	Course to an altitude
r)	CDI	Course deviation indicator
s)	CDU	Control display
t)	CF	Course to a fix
u)	Doc	Document
v)	DF	Direct to a fix
w)	DME	Distance-measuring equipment
x)	DV	Flight dispatcher
y)	EASA	<i>Agencia Europea de Seguridad Aérea</i> (European Air Safety Agency)
z)	EHSI	Enhanced vertical status indicator
aa)	FAA	United States Federal Aviation Administration
bb)	FAF	Final approach fix
cc)	FAP	Final approach point
dd)	FD	Flight director
ee)	FM	Course from a fix to a manual termination
ff)	Fly-by WPT	Fly-by way-point
gg)	Flyover WPT	Flyover way-point
hh)	FMS	Flight management system
ii)	FTE	Flight technical error
jj)	GBAS	Ground-based augmentation system
kk)	GNSS	Global navigation satellite system

ll)	GLONASS	Global navigation satellite system
mm)	GPS	Global positioning system
nn)	GS	Ground speed
oo)	HAL	Horizontal alerting limit
pp)	HSI	Vertical status indicator
qq)	IF	Initial fix
rr)	IFR	Instrument flight rules
ss)	IMC	Instrument meteorological conditions
tt)	LAAS	Local area augmentation system
uu)	LAR	Latin American Aeronautical Regulations
vv)	LNAV	Lateral navigation
ww)	LOA	Letter of authorisation/letter of acceptance
xx)	MCDU	Multi-function control display
yy)	MEL	Minimum equipment list
zz)	MIO	Manual of the operations inspector
aaa)	NM	Nautical miles
bbb)	MP	Monitoring pilot
ccc)	NAVAIDS	Navigation aids
ddd)	NOTAM	Notice to airmen
eee)	NPA	Non-precision approach
fff)	NSE	Navigation system error
ggg)	LNAV	Lateral navigation
hhh)	OACI	International Civil Aviation Organization
iii)	OM	Operations manual
jjj)	OEM	Original equipment manufacturer
kkk)	OpSpecs	Operations specifications
lll)	PA	Precision approach
mmm)	PANS-ATM	Procedures for Air Navigation Services - Air traffic management
nnn)	PANS-OPS	Procedures for Air Navigation Services - Aircraft Operations
ooo)	PBN	Performance-based navigation
ppp)	PDE	Path definition error
qqq)	PEE	Position estimation error
rrr)	PF	Pilot flying
sss)	PNF	Pilot not flying
ttt)	POH	Pilot operations handbook
uuu)	P-RNAV	Precision area navigation
vvv)	PSE	Path direction error

www)	RAIM	Receiver autonomous integrity monitoring
xxx)	RNAV	Area navigation
yyy)	RNP	Required navigation performance
zzz)	RNP APCH	Required navigation performance approach
aaaa)	RNP AR APCH	Required navigation performance authorisation required approach
bbbb)	RTCA	Radio Technical Commission for Aviation
cccc)	SBAS	Satellite-based augmentation system
dddd)	SID	Standard instrument departure
eeee)	SRVSOP	Regional Safety Oversight Cooperation System I
fff)	STAR	Standard instrument arrival
gggg)	STC	Supplementary type certificate
hhh)	TF	Track to a fix
iiii)	TO/FROM	To/from
jjjj)	TSE	Total system error
kkkk)	TSO	Technical standard order
lll)	VA	Heading to a given altitude
mmmm)	VI	Heading to an intercept
nnnn)	VM	Heading to a normal termination
oooo)	VMC	Visual meteorological conditions
pppp)	WAAS	Wide area augmentation system
qqqq)	WGS	World geodetic system
rrrr)	WPT	Waypoint

5. INTRODUCTION

5.1 According to Doc 8168 – Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS) Volume II, the Basic-RNP 1 navigation specification is used in standard instrument departures and arrivals (SIDs and STARs) and in approaches to the final approach fix (FAF)/final approach point (FAP) with or without air traffic service (ATS) surveillance.

5.2 This AC does not establish all the requirements that may be specified for a given operation. These requirements are established in other documents, such as the aeronautical information publication (AIP) and ICAO Doc 7030 – Regional Supplementary Procedures.

5.3 Although the operational approval is normally related to airspace requirements, the operators and flight crews must consider the operational documents required by the CAA before conducting flights in Basic-RNP 1 airspace.

5.4 The material described in this CA has been developed based on the following document:

- ✓ ICAO Doc 9613, Volume II, Part C, Chapter 3 – Implementing Basic-RNP 1.

5.5 To the extent possible, this CA has been harmonised with the following guidance material:

- ✓ FAA AC 90-105 Appendix 2 - Qualification criteria for RNP 1 (terminal) operations

Note.- Despite harmonisation efforts, operators shall take note of the differences between this CA and the aforementioned document when applying for an approval from the corresponding Administration.

6. GENERAL CONSIDERATIONS

6.1 General information

- a) **Performance-based navigation concept.**- The performance-based navigation (PBN) concept represents a change from sensor-based navigation to PBN. The PBN concept specifies the performance requirements of the aircraft RNP system in terms of the precision, integrity, availability, continuity, and functionality required for operations in a given airspace. Performance requirements are identified in the navigation specifications (e.g., the requirements of this AC), which also identify options in terms of navigation sensors, navigation equipment, operating procedures, and training needs to meet performance requirements.
- b) RNP procedures and routes require the use of RNP systems with onboard performance monitoring and alerting. A critical component of RNP is the ability that must have the aircraft navigation systems in combination with the pilot to monitor its achieved navigation performance, and to identify for the pilot whether the operational requirement is or is not met during an operation.

Note.- Compliance with the performance control and alerting requirements does not imply automatic monitoring of the flight technical error (FTE). The on-board performance monitoring and alerting function should consist at least of a navigation system error (NSE) monitoring and alerting algorithm and a lateral navigation display that allow the flight crew to monitor the FTE. To the extent operational procedures are used to control the FTE, the flight crew procedures, equipment characteristics and the facilities are assessed for effectiveness and equivalence, as described in the functional requirements and operating procedures. The path definition error (PDE) is considered negligible due to the quality assurance process and crew procedures.

- c) **Operations with RNP systems.**- RNP operations:
- 1) do not require the pilot to monitor the ground-based navigation aids (NAVAIDs) used for position updating, unless required by the aircraft flight manual (AFM);
 - 2) base obstacle clearance assessments on the associated required system performance;
 - 3) Rely on conventional compliance with descent profiles and altitude requirements;
- Note.- Pilots operating aircraft with an approved barometric vertical navigation (baro-VNAV) system can continue using said system while operating on routes SIDs, and STARs. Operators must ensure compliance with all altitude limitations as published in the procedure in reference to the pressure altimeter.*
- 4) all routes and procedures must be based on the world geodetic system (WGS) of coordinates 84; and
 - 5) the navigation data published for the routes, procedures and supporting NAVAIDs must meet the requirements of Annex 15 to the Convention on International Civil Aviation.

6.2 Navigation aid infrastructure

- a) The GNSS is the main navigation system that supports Basic-RNP 1 operations.
- b) Although RNP systems based on DME/DME are capable of providing Basic-RNP 1 accuracy, the use of this navigation specification has been foreseen mainly for environments where DME infrastructure cannot support DME/DME area navigation with the required performance.
- c) The increased complexity in the DME infrastructure requirements and assessment make Basic-RNP 1 operations based on DME/DME impractical and unprofitable for a general application.
- d) Route design should take into account the navigation performance that can be achieved with the available navigation aid (NAVAID) infrastructure. Although the requirements of RNAV 1 and RNAV 2 navigation systems are identical, NAVAID infrastructure can affect the required performance.
- e) Air navigation service providers (ANSPs) shall ensure that the operators of GNSS equipped aircraft have a means available to predict fault detection using an aircraft-based augmentation system (ABAS) [e.g., receiver autonomous integrity monitoring (RAIM)].
- f) When applicable, the ANSPs shall also ensure that the operators of aircraft equipped with a

satellite-based augmentation system (SBAS) have a means to predict fault detection.

- g) The prediction services may be provided by the ANSP, airborne equipment manufacturers other entities.
- h) Prediction services can only be for receivers that meet the minimum performance of a technical standard order (TSO) or be specific to the receiver design. The prediction service shall use status information on GNSS satellites and a horizontal alerting limit (HAL) appropriate for the operation (1 NM within 30 NM from the aerodrome and 2 NM otherwise).
- i) Outages shall be identified in the event of a predicted, continuous loss of ABAS fault detection of more than 5 minutes for any part of the Basic-RNP 1 operation.
- j) ANSPs must undertake an assessment of the NAVAIDS infrastructure. It must be demonstrated that the assessment is sufficient for the proposed operations, including reversionary modes.

6.3 **Communications and ATS surveillance**

- a) The Basic-RNP 1 navigation specification is intended in environments where ATS surveillance is limited or not available.
- b) Basic-RNP 1 SIDs and STARs are primary intended to be conducted in direct controller-pilot communication environments.

6.4 **Obstacle clearance and horizontal separation**

- a) Doc 8168 (PANS OPS), Volume II, provides detailed guidance on obstacle clearance. The general criteria contained in Parts I and III of said document shall apply.
- b) The obstacle clearance criteria for SIDs, STARs, initial and intermediate approach, final missed approach, holding pattern, and route of the basic RNP 1 navigation specification are described in Doc 8168 (PANS-OPS), Volume II, Part III, Section 1, Chapter 2 and Section 3, Chapters 1, 2, 7 and 8.
- c) Obstacle clearance criteria for final approach and for initial and intermediate missed approach are specific to the classification of non-precision approaches (NPA), approaches with vertical guidance (APV) and precision approaches (PA).
- d) En-route spacing for basic RNP 1 depends on route configuration, air traffic density, and intervention capacity. Horizontal separation standards are published in Doc 4444 – Procedures for air navigation services – Air traffic management (PANS-ATM).

6.5 **Publications**

- a) SIDs, STARs and Basic-RNP 1 procedures must be based on normal descent profiles and must identify minimum altitude requirements of the segments.
- b) The navigation information published in the AIP for support procedures and NAVAIDs must meet the requirements of Annex 15 - Aeronautical information services.
- c) All procedures must be based on the coordinates of the world geodetic system - 84 (WGS-84).
- d) The AIP should clearly indicate whether the navigation application is Basic-RNP 1.
- e) The available navigation infrastructure shall be clearly designated in all the appropriate charts (e.g., GNSS).
- f) The required navigation standard (e.g., Basic-RNP 1) for all Basic-RNP 1 procedures shall be clearly designated in all the appropriate charts.

6.6 **Additional considerations**

- a) For procedure design and infrastructure evaluation, it is assumed that 95% of the normal limit value of the FTE, defined in the operating procedures, is 0.5 NM for the Basic-RNP 1 navigation specification.
- b) The default value of the alerting functionality of a TSO-C129a sensor (stand-alone or integrated)

switches between terminal alerting (± 1 NM) and en-route alerting (± 2 NM) at 30 miles from the airport reference point (ARP).

7. AIRWORTHINESS AND OPERATIONAL APPROVAL

7.1 For a commercial air transport operator to be granted a Basic-RNP 1 approval, it must comply with two types of approvals:

- a) the airworthiness approval, issued by the State of registry (see Article 31 of the Chicago Convention, and Paragraphs 5.2.3 and 8.1.1 of Annex 6 Part I); and
- b) the operational approval, issued by the State of the operator (see paragraph 4.2.1 and Attachment F to Annex 6 Part I).

7.2 For general aviation operators, the State of registry will determine whether or not the aircraft meets the applicable basic RNP 1 requirements and will issue the operational approval (e.g., letter of authorisation – LOA) (see Paragraph 2.5.2.2 of Annex 6 Part II).

7.3 Before filing the application, operators shall review all aircraft qualification requirements. Compliance with airworthiness requirements or equipment installation alone does not constitute operational approval.

8. AIRWORTHINESS APPROVAL

8.1 System and aircraft requirements

8.1.1 Description of the RNP navigation system

a) Lateral navigation (LNAV)

- 1) In LNAV, the RNP equipment allows the aircraft to fly in accordance with the appropriate route instructions along a path defined by waypoints (WPTs) contained in an on-board navigation database.

Note.- LNAV is normally a mode of flight guidance systems, in which the RNP equipment provides path steering commands to the flight guidance system, which controls the FTE through the manual pilot control on a path deviation display or through the coupling of the flight director (FD) or automatic pilot (AP).

- 2) For purposes of this AC, Basic-RNP 1 operations are based on the use of RNP equipment that automatically determines the position of the aircraft on the horizontal plane, using data input from the GNSS.

8.1.2 System performance, control, and alerting

- a) **Accuracy.-** For operations in Basic-RNP 1 designated airspace or routes, total lateral system error must not exceed ± 1 NM during at least 95% of total flight time. Likewise, along-track error must not exceed ± 1 NM during at least 95% of total flight time. In order to meet the accuracy requirement, 95% of the flight technical error (FTE) must not exceed 0.5 NM.

Note.- The use of a deviation indicator with a full-scale deflection of 1 NM constitutes an acceptable means of compliance. The use of a flight director (FD) or an automatic pilot (AP) also represents an acceptable means of compliance (roll stabilization systems do not meet the requirements).

- b) **Integrity.-** Malfunctioning of the aircraft navigation equipment is classified as a major failure according to airworthiness regulations (e.g., 10^{-5} per hour).
- c) **Continuity.-** Loss of function is classified as a minor failure if the operator can revert to a different navigation system and proceed to an appropriate aerodrome.
- d) **Performance monitoring and alerting.-** The RNP system or the RNP system in combination with the pilot will provide an alert if the accuracy requirement is not met, or if the probability that the lateral total system error (TSE) exceeds 2 NM is greater than 10^{-5} per hour.
- e) **Signal-in-space.-** If GNSS is used, the aircraft navigation equipment will provide an alert if the

probability of signal-in-space errors causing a lateral position error greater than 2 NM exceeds 10^{-7} per hour (Annex 10, Volume I, Table 3.7.2.4.1).

8.1.3 Aircraft eligibility requirements for Basic-RNP 1 operations in terminal area

The following systems installed in the aircraft meet the requirements defined in this AC. This equipment requires evaluation by the manufacturer and operator against all the functional and performance requirement established in this AC.

- a) Aircraft with E/TSO-C129a Class A1 system or E/TSO-C146 () system installed for IFR use in accordance with FAA AC 20-138 or AC 20-138A;
- b) Aircraft with E/TSO-C129/C129a sensor (Class B or C) installed in a flight management system (FMS) that meets the criteria of TSO-C115b and installed for IFR use in accordance with AC 20-130A;
- c) Aircraft with E/TSO-C145 () sensor installed in an FMS that meets TSO-C115b requirements and installed for IFR use in accordance with FAA AC 20-130A or AC 20-138A; and
- d) Aircraft with certified RNP capability, or approved based on equivalent standards.

8.1.4 System eligibility requirements for Basic-RNP 1 operations

- a) **Stand-alone systems.-** Stand-alone E/TSO-C129 Class A1 or A2 systems (without deviation from AC 91-008 functional requirements) or E/TSO-C146 Class 1, 2 or 3 systems (without deviation of functional requirements establish in this AC) meet aircraft qualification requirements for Basic-RNP 1 operations. GNSS systems must be approved in accordance with AC 20-138A.
- b) **Multi-sensor systems.-** Multi-sensor systems using E/TSO-C129 Class B or C sensors or E/TSO-C145 Class 1, 2 and 3 sensors, meet aircraft qualification requirements for Basic-RNP 1 operations, provided that the installations comply with the criteria of this AC. RNP systems must be installed in accordance with AC 20-138A and the associated FMS must comply with E/TSO-C115b and AC 20-130A.

8.2 Qualification documentation

a) Aircraft qualification documentation

- 1) Aircraft or avionics manufacturers must produce aircraft qualification documentation showing compliance with the applicable criteria, as appropriate. For aircraft not approved for flying Basic-RNP 1 procedures, aircraft and avionics manufacturers must develop aircraft qualification documentation showing compliance with this AC, provided the equipment is properly installed and operated. The necessary documentation shall also define the appropriate maintenance procedures. This documentation is not required for aircraft that have an AFM or AFM supplement that explicitly states that the RNP system is approved for operations with values of RNP 1 or lower, and that the equipment meets the reliability and performance requirements of the following documents: AC 20-138A, AC 20-130A, E/TSO-C115b and AC 20-129, as applicable.
- 2) Operators will submit this documentation, together with the formal application, in Phase 2 of the approval process.

b) Acceptance of documentation by the CAA

- 1) *For new aircraft/equipment (capability shown in production).-* The new aircraft/equipment qualification documentation may be approved as part of an aircraft certification project, and will be reflected in the AFM and related documents.
- 2) *For aircraft/equipment in use.-* Previous approvals to conduct RNAV 1 procedures using the GNSS (GPS), according to AC 91-003 or AC 90-100/AC 90-100A, do not require an additional assessment, provided it is shown that the RNAV equipment meets the on-board performance monitoring and alerting requirements. For installations/equipment that are not eligible for conducting Basic-RNP 1 procedures, the operator shall send the Basic-RNP 1 and aircraft qualification documentation to the corresponding bodies of the CAA (e.g.,

Aircraft certification division or Airworthiness inspection division, or equivalents).

- 3) The corresponding bodies of the CAA, as appropriate, will accept the data package for Basic-RNP 1 operations. This acceptance will be documented in a letter to the operator.

8.3 **Aircraft and systems eligibility for Basic-RNP 1 operations in terminal area**

8.3.1 **Aircraft that have a statement of compliance with respect to the criteria of this AC.-** Aircraft that have a statement of compliance with respect to the criteria set forth in this AC or equivalent document (e.g., FAA AC 90-105 Appendix 2) in the AFM, AFM supplement, pilot operating handbook (POH) or avionics operating manual, meet the performance and functional requirements of this CA.

8.3.2 **Aircraft with a statement by the manufacturer.-** Aircraft that have a statement by the manufacturer documenting compliance with the criteria set forth in this AC or equivalent meet the performance and functional requirements of this document. This statement must include the airworthiness basis for compliance. The aircraft or equipment manufacturer will determine compliance with sensor requirements, while the operator will determine, through inspection, compliance with the functional requirements of this document.

8.3.3 For modified aircraft, the original equipment manufacturer (OEM) or the holder of the aircraft installation approval, e.g., the holder of a supplemental type certificate (STC), will demonstrate compliance to the CAA, and the approval can be submitted in the documentation of the manufacturer (e.g., service letters).

8.3.4 Stand-alone GNSS systems must be approved according to E/TSO-C129a Class A1 or E/TSO-C146 and operational Class 1, 2 or 3 (with no deviation from the functional requirements described in this AC), and installed for IFR use in accordance with AC 20-138A.

8.3.5 Aircraft with E/TSO-C129a sensor(s) Class B or C or E/TSO-C145 sensor(s) and FMS that meet E/TSO-C115b requirements and are installed for IFR use according to FAA AC 20-130A.

8.3.6 Aircraft/equipment approved under SRVSOP AC 91-003 or equivalent (e.g., FAA AC 90-100A) for the use of GNSS, are approved under this AC for Basic-RNP 1 operations.

8.3.7 RNP aircraft with P-RNAV approval based on GNSS capability meet the functional requirements of this AC for Basic-RNP 1 operations, such as SIDs y STARs. The GNSS system approved according to E/TSO-C129 and satisfying the step-detection and health word checking contained in E/TSO-C129A, meets P-RNAV performance requirements.

Note.- Basic-RNP 1 operations are based on GNSS positioning. Positioning data from other navigation sensors can be integrated into GNSS data provided they do not cause position errors that exceed the total system error (TSE) budget. Otherwise, means to deselect or cancel the other types of navigation sensors must be provided.

8.4 **Functional requirements**

Appendix 1 contains the functional requirements that meet the criteria of this document.

8.5 **Continued airworthiness**

- a) The operators of aircraft approved to perform Basic-RNP 1 operations, must ensure the continuity of the technical capacity of them, in order to meet technical requirements established in this AC.
- b) Each operator who applies for Basic-RNP 1 operational approval shall submit to the CAA of State of registry, a maintenance and inspection program that includes all those requirements of maintenance necessary to ensure that navigation systems continue fulfilling the Basic-RNP 1 approval criteria.
- c) The following maintenance documents must be revised, as appropriate, to incorporate Basic-RNP 1 aspects:
 - 1) Maintenance control manual (MCM);
 - 2) Illustrated parts catalogs (IPC); and

- 3) Maintenance program.
- d) The approved maintenance program for the affected aircrafts should include maintenance practices listed in maintenance manuals of the aircraft manufacturer and its components, and must consider:
 - 1) that equipment involved in the Basic-RNP 1 operation should be maintained according to directions given by manufacturer's components;
 - 2) that any amendment or change of navigation system affecting in any way Basic-RNP 1 initial approval, must be forwarded and reviewed by the CAA for its acceptance or approval of such changes prior to its implementation; and
 - 3) that any repair that is not included in the approved/accepted maintenance documentation, and that could affect the integrity of navigation performance, should be forwarded to the CAA for acceptance or approval thereof.
- e) Within the Basic-RNP 1 maintenance documentation should be presented the training program of maintenance personnel, which inter alia, should include:
 - 1) PBN concept;
 - 2) Basic-RNP 1 application;
 - 3) equipment involved in an Basic-RNP 1 operation; and
 - 4) MEL use.

9. OPERATIONAL APPROVAL

Airworthiness approval alone does not authorise an applicant or operator to conduct basic RNP 1 operations. In addition to the airworthiness approval, the applicant or operator must obtain an operational approval to confirm the suitability of normal and contingency procedures in connection to the installation of a given piece of equipment.

Concerning commercial air transport, the assessment of an application for Basic-RNP 1 operational approval is done by the State of the operator, in accordance with standing operating rules (e.g., LAR 121.995 (b) and LAR 135.565 (c) or equivalents) supported by the criteria described in this AC.

For general aviation, the assessment of an application for Basic-RNP 1 operational approval is carried out by the State of registry, in accordance with standing operating rules (e.g., LAR 91.1015 and LAR 91.1640 or equivalents) supported by the criteria established in this AC.

9.1 Requirements to obtain operational approval

9.1.1 In order to obtain Basic-RNP 1 approval, the applicant or operator will take the following steps, taking into account the criteria established in this paragraph and in Paragraphs 10, 11, 12, and 13:

- a) *Airworthiness approval.*- Aircraft shall have the corresponding airworthiness approvals, pursuant to Paragraph 8 of this CA.
- b) *Application.*- The operator shall submit the following documentation to the CAA:
 - 1) *Basic-RNP 1 operational approval application;*
 - 2) *Description of aircraft equipment.*- The operator shall provide a configuration list with details of the relevant components and the equipment to be used for Basic-RNP 1 operations. The list shall include each manufacturer, model, and equipment version of GNSS equipment and software of the installed FMS.
 - 3) *Airworthiness documents related to aircraft eligibility.*- The operator shall submit relevant documentation, acceptable to the CAA, showing that the aircraft is equipped with RNP systems that meet the Basic-RNP 1 requirements, as described in Paragraph 8 of this AC.

For example, the operator will submit the parts of the AFM or AFM supplement that contain the airworthiness statement.

- 4) *Training programme for flight crews and flight dispatchers (DV)*
 - (a) Commercial operators (e.g., LAR 121 and LAR 135 operators) will present to the CAA the Basic-RNP 1 training curriculums to show that the operational procedures and practices and the training aspects described in Paragraph 11 have been included in the initial, upgrade or recurrent training curriculums for flight crews and DV.

Note.- It is not necessary to establish a separate training programme if the Basic-RNP 1 training identified in Paragraph 11 has already been included in the training programme of the operator. However, it must be possible to identify what aspects of Basic-RNP 1 are covered in the training programme.
 - (b) Private operators (e.g., LAR 91 operators) shall be familiar with and demonstrate that they will perform their operations based on the practices and procedures described in Paragraph 11.
- 5) *Operations manual and checklists*
 - (a) Commercial operators (e.g., LAR 121 and 135 operators) must review the operations manual (OM) and the checklists in order to include information and guidance on the operating procedures detailed in Paragraph 10 of this AC. The appropriate manuals must contain the operating instructions for navigation equipment and contingency procedures. The manuals and checklists must be submitted for review along with the formal application in Phase 2 of the approval process.
 - (b) Private operators (e.g., LAR 91 operators) must operate their aircraft based on the practices and procedures identified in Paragraph 10 of this CA.
- 6) *Minimum Equipment List (MEL).*- The operator will send to the CAA for approval any revision to the MEL that is necessary to conduct Basic-RNP 1 operations. If a Basic-RNP 1 operational approval is granted based on a specific operational procedure, operators must modify the MEL and specify the required dispatch conditions.
- 7) *Maintenance.*- The operator will submit for approval a maintenance programme to conduct Basic-RNP 1 operations.
- 8) *Training programme for maintenance personnel.*- Operators will submit the training curriculums that correspond to maintenance personnel in accordance with Paragraph 8.5 e).
- 9) *Navigation data validation programme.*- The operator will present the details about the navigation data validation programme as described in Appendix 2 to this AC.
- c) *Training.*- Once the amendments to manuals, programmes, and documents submitted have been accepted or approved, the operator will provide the required training to its personnel.
- d) *Validation flight.*- The CAA may deem it advisable to perform a validation flight before granting the operational approval. Such validation can be performed on commercial flights. The validation flight will be carried out according to the provisions of Chapter 13, Volume II, Part II of the SRVSOP Operations Inspector Manual (MIO) of the Regional Safety Oversight Cooperation System (SRVSOP).
- e) *Issuance of the approval to conduct Basic-RNP 1 operations.*- Once the operator has successfully completed the operational approval process, the CAA will grant the operator the authorization to conduct Basic-RNP 1 operations.
 - 1) LAR 121 and/or 135 operators.- For LAR 121 and/or LAR 135 operators, the CAA will issue the corresponding operations specifications (OpSpecs) that will reflect the basic RNP 1 approval.
 - 2) LAR 91 operators.- For LAR 91 operators, the CAA will issue a letter of authorization

(LOA).

10. OPERATING PROCEDURES

10.1 The operator and the flight crews will become familiar with the following operating and contingency procedures associated with Basic-RNP 1 operations.

a) Pre-flight planning

- 1) Operators and pilots intending to conduct Basic-RNP 1 SIDs and STARs must fill out the appropriate boxes in the ICAO flight plan.
- 2) On-board navigation data must be current and include appropriate procedures.

Note.- It is expected that the navigation database will be up to date during the operation. If the AIRAC cycle expires during the flight, operators and pilots shall establish procedures to ensure the precision of navigation data, including the suitability of navigation facilities used to determine the routes and procedures for the flight. Normally, this is done comparing electronic data with written documents. An acceptable means of compliance is to compare aeronautical charts (new and old) to check navigation reference points before dispatch. If an amended chart is published for the procedure, the database must not be used to conduct the operation.

- 3) The availability of the NAVAID infrastructure required for the intended routes, including any non-RNP contingency, must be confirmed for the period of intended operations, using all available information. Since Annex 10 Volume I requires GNSS integrity (RAIM or SBAS), it is also necessary to confirm appropriate availability of these devices. For aircraft that navigate with SBAS receivers [all TSO-C145 () / C146 () receivers], operators shall confirm appropriate availability of the GNSS RAIM in areas where the SBAS signal is not available.
- 4) RAIM (ABAS) availability
 - (a) RAIM levels required for Basic-RNP 1 can be verified either through NOTAMs (where available) or through prediction services. Operators must be familiar with the prediction information available for the intended route.
 - (b) For systems whose integrity is based on RAIM, RAIM prediction must be done before departure. This capability can be provided by a ground service or through the RAIM prediction capability of the aircraft on-board receiver.
 - (c) The prediction of RAIM availability must take into account the last NOTAMs of the GPS constellation and the avionics model (if available). The RAIM prediction service can be provided through the ANSPs, the avionics manufacturers, other entities, or through the RAIM prediction capability of the aircraft on-board receiver. RAIM availability can be confirmed using a model-specific RAIM prediction software.
 - (d) The predictive capability must account for known and predicted outages of GPS satellites or other effects on the navigation system sensors. The prediction programme should not use a mask angle below 5 degrees, since operational experience indicates that satellite signals on low elevations are not reliable. RAIM availability prediction should take into account the latest GPS constellation notices to airmen (NOTAMs) issued by the CAA or by the ANSPs, and use an identical algorithm to that used in the airborne equipment or an algorithm based on assumptions for RAIM prediction that provides a more conservative result.
 - (e) In the event that a continuous loss of the appropriate failure detection level is forecast for more than five (5) minutes for any portion of the Basic-RNP 1 operation, the flight plan shall be revised (e.g., delaying the departure or planning a different departure procedure).
 - (f) The RAIM availability prediction software does not guarantee the service. This software is rather a tool for assessing the expected capacity to meet the required

navigation performance. Due to unplanned failures of some GNSS elements, pilots and ANSPs must understand that both RAIM and GNSS navigation can be lost while the aircraft is on flight, which may require reversal to an alternate means of navigation. Therefore, pilots must assess their navigation capabilities (potentially to an alternate aerodrome) in case of failure of GNSS navigation. If system integrity needs to be verified, the RAIM prediction programme shall meet the criteria of FAA AC 20-138, Paragraph 12.

- (g) For aircraft navigating with SBAS receivers (all E/TSO-C145/C146), operators must take into account the latest GPS constellation and SBAS NOTAMs. Operators must also check appropriate GPS RAIM availability in areas where SBAS signal is unavailable.

b) **General operating procedures**

- 1) The pilot shall comply with any instruction or procedure identified by the manufacturer, as necessary, to meet the performance requirements of this section.

Note.- Pilots must adhere to any AFM limitation or operating procedure required to maintain Basic-RNP 1 performance.

- 2) Operators and pilots shall not request or file Basic-RNP 1 routes, SIDs or STARs, unless they meet all the criteria set forth in this AC. If an aircraft that does not meet these criteria and is cleared by the ATC to conduct a Basic-RNP 1 procedure, the pilot will notify the ATC that it cannot accept such clearance and will request alternate instructions;

- 3) At system initialization, pilots must:

- (a) confirm that the navigation database is current;
- (b) verify that the aircraft position has been entered correctly;
- (c) verify the appropriate entry of the assigned ATC route once they receive the initial clearance, and of any subsequent change in route; and
- (d) ensure that the sequence of WPTs as depicted in their navigation system matches the route drawn in the appropriate charts and the assigned route.

- 4) Pilots shall not fly a Basic-RNP 1 procedure, unless it can be retrievable from the on-board navigation database by its name, and conforms with the procedure in the chart. However, the procedure can be modified afterwards by inserting or deleting specific WPTs in response to ATC clearance. Manual entry or the creation of new WPTs through manual insertion of latitude and longitude or rho/theta values is not permitted. Likewise, pilots must not change any type of WPT from a fly-by WPT to a flyover WPT or *vice versa*.

- 5) Flight crews shall cross-check the cleared flight plan by comparing charts or other applicable resources to the navigation system text displays and aircraft map displays, as applicable. If required, the exclusion of specific NAVAIDs must be confirmed. A procedure shall not be used if there are any doubts about the validity of the procedure in the navigation database.

Note.- Pilots may note a small difference between the navigation information described in the chart and the primary navigation display. Differences of 3° or less may result from applying the magnetic variation to the equipment of the manufacturer, and these are operationally acceptable.

- 6) A cross-check is not required for conventional NAVAIDs, since the absence of integrity alert is considered sufficient to meet integrity requirements. However, it is suggested that the navigation reasonableness be checked, and any loss of RNP capability must be reported to the ATC.

- 7) For Basic-RNP 1 procedures, pilots must use a lateral deviation indicator, an FD or an AP in lateral navigation mode (LNAV). Pilots of aircraft with a lateral deviation display must make sure that the lateral deviation scale is appropriate for the navigation precision

associated to the route/procedure (e.g., full-scale deflection: ± 1 NM for Basic-RNP 1).

- 8) All pilots are expected to follow the route centreline, as represented on the on-board lateral deviation indicators and/or flight guidance, during all Basic-RNP 1 operations, unless cleared by the ATC to deviate or due to an emergency. For normal operations, the cross-track error/deviation (the difference between the path estimated by the RNP system and the position of the aircraft relative to the path, e.g. FTE) must be limited to $\pm \frac{1}{2}$ the navigation precision associated with the procedure (e.g., 0.5 NM for basic RNP 1). Small lateral deviations from this requirement are allowed (e.g., overshooting or undershooting the path) during or immediately after a turn, up to a maximum of 1 times the navigation precision (1xRNP) (e.g., 1 NM for basic RNP 1).

Note.- Some aircraft do not display or do not estimate a path during turns. Pilots of such aircraft may not be capable of meeting the $\pm \frac{1}{2}$ precision requirement during en-route turns; however, they are expected to meet interception requirements after the turn or in straight segments.

- 9) If the ATC issues a course assignment that places the aircraft out of the route, the pilot shall not modify the flight plan in the RNP system until a new clearance is received allowing the aircraft to return to the route or until the controller confirms a new route clearance. When the aircraft is not on the published Basic-RNP 1 route, the specified precision requirements do not apply.
- 10) Manual selection of functions that limit the banking angle of the aircraft can reduce the ability of the aircraft to maintain its desired track and is not recommended. Pilots should acknowledge that manual selection of functions that limit the banking angle of the aircraft could reduce their ability to meet ATC path expectations, especially when turns with large banking angles are performed. This cannot be construed as a requirement to deviate from AFM procedures. Pilots must be encouraged to select such functions only within accepted procedures.
- 11) Pilots operating aircraft that have a barometric vertical navigation system (baro-VNAV) can continue using said system while conducting Basic-RNP 1 SID and STAR procedures. Operators must ensure compliance with all altitude limitations, as published in the procedure, using the barometric altimeter as reference. Use of the barometric vertical navigation capability of the aircraft will be subject to the level of familiarisation and training of the flight crew, and on any other operational approval requirement.
- 12) Before starting a Basic-RNP 1 procedure, flight crews must:
 - (a) confirm that the correct procedure has been selected. This process includes verifying WPT sequence, the reasonableness of track angles, distances, and of any other parameter that can be modified by the pilot, such as altitude or speed constraints; and
 - (b) for multi-sensor systems, verify that the correct sensor is being used for position computation.

c) **Aircraft with RNP selection capability**

Pilots of aircraft with the capability of selecting RNP input must select RNP 1 or lower for Basic-RNP 1 SIDs, STARs or procedures.

d) **Basic-RNP 1 SID specific requirements**

- 1) Before beginning take-off, the pilot must verify that the airborne Basic-RNP 1 system is available and operating correctly, and that the appropriate aerodrome and runway data have been loaded. Before the flight, pilots must verify that the airborne navigation system is operating correctly and that the appropriate runway and departure procedure (including any applicable en-route transition) have been loaded and are properly displayed. Pilots assigned to a Basic-RNP 1 departure procedure and subsequently receive a change of runway, procedure or transition, must verify that the appropriate changes have been entered and are available for navigation before take-off. A final

check of proper runway entry and correct route depiction, shortly before take-off, is recommended.

- 2) *Altitude for engagement the RNAV equipment.*- The pilot must be capable of connecting the RNP equipment in order to follow the flight guidance in the RNP lateral navigation mode before reaching 153 m (500 ft) above the aerodrome elevation.
- 3) Pilots must use an authorised method (lateral deviation indicator/navigation map display/FD/AP) to achieve an appropriate level of performance for Basic-RNP 1.
- 4) *GNSS aircraft.*- When a GNSS is used, the signal must be obtained before starting the take-off roll. For aircraft using E/TSO-C129a equipment, the take-off aerodrome must be loaded into the flight plan in order to achieve the appropriate navigation system monitoring and sensitivity. For aircraft using E/TSO-C145 ()/C146 () equipment, if the departure starts at a runway waypoint (WPT), then the departure aerodrome does not need to be in the flight plan in order to obtain the appropriate monitoring and sensitivity mentioned above. If a Basic-RNP 1 SID extends beyond 30 NM from the aerodrome and a lateral deviation indicator is used, its full-scale sensitivity must be set to a value not greater than 1 NM between 30 NM from the aerodrome and the termination of the Basic-RNP 1 SID.
- 5) For aircraft using a lateral deviation display (e.g., a navigation map display), the scale must be adjusted for the Basic-RNP 1 SID and FD or AP must be used.

e) **Basic-RNP 1 STAR specific requirements**

- 1) Before the arrival phase, the flight crew shall verify that the correct terminal route has been loaded. The active flight plan shall be checked, comparing the charts to the map display (if applicable) and the multi-function control display unit (MCDU). This includes confirmation of WPT sequence, the reasonableness of track angles and distances, any altitude or speed constraints, and, whenever possible, which are fly-by WPTs and which are flyover WPTs. If required by a route, a check will need to be made to confirm that updating will exclude a particular NAVAID. A route will not be used if there are doubts about its validity in the navigation database.

Note.- As a minimum, verifications in the arrival phase could consist of a simple inspection of a suitable map display that will meet the objectives of this paragraph.

- 2) The creation of new WPTs by the flight crew through manual entries into the Basic-RNP 1 system will invalidate any route, and is not permitted.
- 3) When contingency procedures require reverting to a conventional arrival route, the flight crew must make the necessary preparations before starting the Basic-RNP 1 procedure.
- 4) Modification made to a route in the terminal area may take the form of radar headings or "direct to" clearances. In this sense, the flight crew must be capable of reacting in time. This may include the insertion of tactical WPTs loaded from the database. The flight crew is not allowed to make manual entries or to modify a loaded route, using temporary WPT or fixes not provided in the database.
- 5) Pilots must verify that the aircraft navigation system is operating properly and that the correct arrival procedure and runway are properly entered and displayed.
- 6) Although a particular method is not mandated, any published altitude and speed constraints must be observed.
- 7) Aircraft with E/TSO-C129a GNSS RNP systems: If a Basic-RNP 1 STAR begins beyond 30 NM from the aerodrome and a lateral deviation indicator is used, its full-scale sensitivity must be set to a value not greater than 1 NM before commencing the STAR. For aircraft that use a lateral deviation display (e.g., a navigation map display), the scale must be adjusted to the Basic-RNP 1 STAR and the FD or AP must be used.

f) **Contingency procedures**

- 1) The pilot must notify the ATC of any loss of RNP capability (integrity alerts or loss of navigation), together with the proposed course of action. If, for any reason, it is not possible to meet the requirements of a Basic-RNP 1 SID or STAR, pilots must notify the ATS as soon as possible. Loss of RNP capability includes any failure or event that causes the aircraft to be unable to meet the Basic-RNP 1 requirements of the route.
- 2) In case of a communication failure, the flight crew must continue with the established procedure for loss of communication.

11. TRAINING PROGRAMMES

11.1 The training programme for flight crews and flight dispatchers (DV) shall provide sufficient training (e.g., using flight training devices, flight simulators and aircraft) on the RNP system to the extent necessary. The training programme will include the following topics:

- a) information about this AC;
- b) the meaning and proper use of aircraft equipment and navigation suffixes;
- c) the procedures characteristics as determined from chart depiction and textual description;
- d) the depiction of WPTs types (fly-by and flyover) and ARINC 424 path terminators provided in Appendix 1 to this AC and any other types used by the operator, as well as those associated with the aircraft flight paths;
- e) the navigation equipment required to conduct Basic-RNP 1 SIDs and STARs.
- f) specific information on the RNP system:
 - 1) levels of automation, annunciation modes, changes, alerts, interactions, reversals, and degradation;
 - 2) integration of functions with other aircraft systems;
 - 3) the meaning and appropriateness of route discontinuities as well as related flight crew procedures;
 - 4) pilot procedures consistent with the operation;
 - 5) types of navigation sensors (e.g., GNSS) used by the RNP system and associated system prioritization, weighting and logic;
 - 6) turns anticipation, taking into account the effects of speed and altitude;
 - 7) interpretation of electronic displays and symbols;
 - 8) understanding aircraft configuration and operational conditions required to support Basic RNP 1 operations; e.g., appropriate selection of the lateral deviation indicator (CDI) scaling;
- g) operating procedures for RNP equipment, as applicable, including how to perform the following:
 - 1) verify currency and integrity of aircraft navigation data;
 - 2) verify the successful completion of RNP system self-tests;
 - 3) initialize RNP system position;
 - 4) retrieve and fly a Basic-RNP 1 SID or STAR with the appropriate transition;
 - 5) adhere to speed and altitude constraints associated with a Basic-RNP 1 SID or STAR;
 - 6) select the appropriate Basic-RNP 1 SID or STAR for the active runway and become familiar with the procedures to deal with a runway change;
 - 7) verify WPTs and flight plan programming;

- 8) fly direct to a WPT;
 - 9) fly a course/track to a WPT;
 - 10) intercept a course/track;
 - 11) fly radar vectors and rejoining a Basic-RNP 1 route from a “heading” mode;
 - 12) determine cross-track errors and deviations; specifically, the maximum allowable deviations to support Basic-RNP 1 must be understood and respected;
 - 13) resolve route discontinuities (insert and delete/eliminate en-route discontinuities);
 - 14) remove or reselect the navigation sensor inputs;
 - 15) when required, confirm the exclusion of a specific NAVAID or a type of navigation aid;
 - 16) change the arrival and alternate aerodromes;
 - 17) perform parallel offset if that capability is available. Pilots must know how to apply offsets, the functionality of the particular RNP system, and the need to advise the ATC if this functionality is not available; and
 - 18) perform RNP holding pattern functions (e.g., insert or delete a holding pattern).
- h) levels of automation recommended by the operator for each flight phase and workload, including the methods to minimise cross-track error that will permit the aircraft to follow the route centreline;
- i) radiotelephony phraseology used for RNP applications; and
- j) RNP failure contingency procedures.

12. NAVIGATION DATABASE

- a) The operator must obtain the navigation database from a supplier that complies with RTCA (Radio Technical Commission for Aeronautics) document DO 200A/EUROCAE ED 76 – Standards for aeronautical data processing. Navigation data must be compatible with the foreseen function of the equipment (see Annex 6 Part I paragraph 7.4.1). A letter of acceptance (LOA) issued by the appropriate regulatory authority to each participant in the data chain shows compliance with this requirement (e.g., FAA LOA issued in accordance with FAA AC 20-153 or EASA LOA issued in accordance with EASA IR 21 Subpart G).
- b) The operator must advise the navigation data supplier of discrepancies that invalidate a SID or STAR, and prohibit their use through a notice to flight crews.
- c) Operators should consider the need to check the navigation database periodically in order to maintain the requirements of the existing quality system or safety management system.

Note.- In order to minimise the path definition error (PDE), the database shall comply with DO 200A or there must be an equivalent operational means available to ensure database integrity for the Basic-RNP 1 SIDs or STARs.

13. OVERSIGHT, INVESTIGATION OF NAVIGATION ERRORS, AND WITHDRAWAL OF BASIC-RNP 1 APPROVAL

- a) The operator will establish a procedure to receive, analyse, and follow up on navigation error reports in order to determine appropriate corrective action.
- b) Information indicating a potential for repetitive errors may require the modification of the training programme of the operator.
- c) Information attributing multiple errors to a pilot in particular may call for additional training or a license revision for that pilot.
- d) Repetitive navigation errors attributed to the equipment or a specific part of the navigation

equipment or to operating procedures can be the cause of cancellation of an operational approval (withdrawal of Basic-RNP 1 OpSpecs authorisation or withdrawal of the LOA in the case of private operators).

APPENDIX 1

FUNCTIONAL REQUIREMENTS

Paragraph	Functional requirements	Explanation
a)	<p>Navigation data, including the to/from indication and a failure indicator, must be displayed on a lateral deviation display [e.g., a course deviation indicator (CDI), an enhanced horizontal situation indicator (E)HSI) and/or a navigation map display]. These lateral deviation displays will be used as primary flight instruments for the navigation of the aircraft, for manoeuvre anticipation, and for indication of failure/status/integrity. They must meet the following requirements:</p>	<p>1) Non-numeric lateral deviation display (e.g. CDI, (E)HSI)), with a to/from indication and a failure annunciation, for use as primary flight instruments for navigation of the aircraft, for manoeuvre anticipation, and for failure/status/integrity indication, with the following five attributes:</p> <ul style="list-style-type: none"> (a) The displays must be visible to the pilot and located in the primary field of view (± 15 degrees from the pilot's normal line of sight) when looking forward along the flight path. (b) The lateral deviation display scaling should agree with any alerting and annunciation limits, if implemented. (c) The lateral deviation display must also have a full-scale deflection suitable for the current phase of flight and must be based on the required total system accuracy. (d) The display scaling may be set automatically by default logic or set to a value obtained from a navigation database. The full-scale deflection value must be known or must be available for display to the pilot commensurate with en-route, terminal, or approach values. (e) The lateral deviation display must be automatically slaved to the RNP computed path. The course selector of the deviation display should be automatically slewed to the RNP computed path. <p><i>Note.- The normal functions of the autonomous GNSS meet this requirement.</i></p> <p>2) As an alternate means, a navigation map display should give equivalent functionality to a lateral deviation display as described in Paragraph a) 1) from (a) to (e), with appropriate map scales which may be set manually by the pilot.</p> <p><i>Note.- A number of modern aircraft eligible for this specification use a map display as an acceptable means to meet the prescribed requirements.</i></p>

Paragraph	Functional requirements	Explanation
b)	The following functions of the basic RNP 1 system are required as a minimum:	<ol style="list-style-type: none"> 1) The capability to continuously display to the pilot flying (PF), on the primary flight navigation instruments (primary navigation displays), the RNP calculated desired path and the position of the aircraft relative to that path. For operations where the minimum flight crew consists of two pilots, the means for the pilot not flying (PNF) the aircraft or monitoring pilot (MP) to verify the desired path and the aircraft position relative to that path must also be provided; 2) A navigation database containing current navigation data officially issued for civil aviation, which can be updated in accordance with the aeronautical information regulation and control (AIRAC) cycle and from which ATS routes can be retrieved and loaded into the RNP system. The resolution of the stored data must be sufficient to achieve an insignificant path definition error (PDE). The database must be protected against any modification of the stored data by the flight crew; 3) The means to display to the flight crew the period of validity of the navigation database; 4) The means to retrieve and display the data stored in the navigation database relating to individual waypoints and NAVAIDs, to enable the flight crew to verify the route to be flown; and 5) The capability to load on the Basic-RNP 1 system, from the navigation database, the complete RNP segment of the SIDs or STARs to be flown. <p><i>Note.- Due to the variability of RNP systems, this document defines the RNP segment from the first occurrence of a named WPT, track or course up to the last occurrence of a named WPT, track or course. Legs or segments prior to the first named WPT or after the last named WPT must not be loaded from the navigation database. Heading legs prior to the first named WPT or after the last named WPT do not have to be loaded from the navigation database. The complete SID will be considered in the Basic-RNP 1 procedure.</i></p>
c)	The means to display the following items, either on the primary field of view of the pilots, or on a readily accessible display page [e.g., on a multi-function control display unit	<ol style="list-style-type: none"> 1) The active navigation sensor type; 2) The identification of the active (to) waypoint; 3) The ground speed or time to the active (to) waypoint; and

Paragraph	Functional requirements	Explanation
	(MCDU):	4) The distance and bearing to the active (to) waypoint.
d)	The capability of execute a "direct to" function.	
e)	The capability for automatic leg sequencing with the display of sequencing to the flight crew.	
f)	The capability to execute Basic-RNP 1 terminal procedures extracted from the on-board database, including the capability to execute flyover and fly-by turns.	
g)	<p>The aircraft must have the capability to automatically execute leg transitions and maintain tracks consistent with the following ARINC 424 path terminators or their equivalent:</p> <ul style="list-style-type: none"> ➤ Initial fix (IF); ➤ Course to a fix (CF); ➤ Direct to a fix (DF); and ➤ Track to a fix (TF). 	<p>Note 1.- Path terminators are defined in the ARINC 424 specification, and their application is described in more detail in RTCA documents DO-236B and DO-201A and in EUROCAE ED-75B and ED-77</p> <p>Note 2.- Numeric values for courses and tracks must be automatically loaded from the RNP system database.</p>
h)	The aircraft must have the capability to automatically execute leg transitions consistent with the following ARINC 424 path terminators: heading to an altitude (VA), heading to a manual termination (VM) and heading to an intercept (VI), or must be able to be manually flown on a heading to intercept a course or to fly direct to another fix after reaching an altitude of a specific procedure.	
i)	The aircraft must have the capability to automatically execute leg transitions consistent with the following ARINC 424 path terminators: course to an altitude (CA) and course from a fix to a manual termination (FM), or the RNP	

Paragraph	Functional requirements	Explanation
	system must permit the pilot to readily designate a waypoint and select a desired course to or from a designated waypoint.	
j)	The capability to load an Basic-RNP 1 procedure from the database into the RNP system by its name.	
k)	The capability to display an indication of the Basic-RNP 1 system failure in the pilot's primary field of view.	
l)	Database integrity	The navigation database suppliers must comply with RTCA DO-200/EUROCAE document ED 76 - Standards for processing aeronautical data. A Letter of acceptance (LOA) issued by the appropriate regulatory authority to each of the participants in the data chain demonstrates compliance with this requirement. Discrepancies that invalidate a route must be reported to database suppliers and the affected routes must be prohibited through a notice from the operator to its flight crews. Aircraft operators must consider the need to conduct periodic checks of the navigation databases in order to meet existing safety system requirements.

APPENDIX 2**NAVIGATION DATA VALIDATION PROGRAMME****1. INTRODUCTION**

The information stored in the navigation database defines the lateral and longitudinal guidance of the aircraft for Basic-RNP 1 operations. Navigation database updates are carried out every 28 days. The navigation data used in each update are critical to the integrity of every basic RNP 1 procedure, SID and STAR. This appendix provides guidance on operator procedures to validate the navigation data associated with the Basic-RNP 1 operations.

2. DATA PROCESSING

- a) The operator will identify in its procedures the person responsible for the navigation data updating process.
- b) The operator must document a process for accepting, verifying, and loading navigation data into the aircraft.
- c) The operator must place its documented data process under configuration control.

3. INITIAL DATA VALIDATION

3.1 The operator must validate every Basic-RNP 1 procedure, SID and STAR before flying under instrument meteorological conditions (IMC) to ensure compatibility with the aircraft and to ensure that the resulting paths are consistent with the published procedures, SIDs and STARs. As a minimum, the operator must:

- a) compare the navigation data of Basic-RNP 1 procedures, SIDs, and STARs to be loaded into the FMS with valid charts and maps containing the published procedures, SIDs, and STARs.
- b) validate the navigation data loaded for Basic-RNP 1 procedures, SIDs, and STARs, either on the flight simulator or on the aircraft, under visual meteorological conditions (VMC). Basic-RNP 1 procedures, SIDs, and STARs outlined on a map display must be compared to the published procedures, SIDs, and STARs. Complete Basic-RNP 1 procedures, SIDs, and STARs must be flown in order to ensure that the paths can be used, that they have no apparent lateral or longitudinal discrepancies, and that they are consistent with the published routes, SIDs, and STARs.
- c) Once the Basic-RNP 1 procedures, SIDs, and STARs are validated, a copy of the validated navigation data shall be kept and maintained in order to compare them with subsequent data updates.

4. DATA UPDATING

Upon receiving a navigation data update and before using such data on the aircraft, the operator must compare the update with the validated procedures, SIDs or STARs. This comparison must identify and resolve any discrepancy in the navigation data. If there are significant changes (any change affecting the path or the performance of the procedures, SIDs and STARs) in any part of the procedure, SID, and STAR, and if those changes are verified through the initial data, the operator must validate the amended route in accordance with the initial validation data.

5. NAVIGATION DATA SUPPLIERS

Navigation data suppliers must have a letter of acceptance (LOA) in order to process these data (e.g., FAA AC 20-153 or the document on the conditions for the issuance of letters of acceptance to navigation data suppliers by the European Aviation Safety Agency – EASA (EASA IR

21 Subpart G) or equivalent documents). A LOA recognises the data supplier as one whose data quality, integrity and quality management practices are consistent with the criteria of DO-200A/ED-76. The database supplier of an operator must have a Type 2 LOA and its respective suppliers must have a Type 1 or 2 LOA. The CAA may accept a LOA issued to navigation data suppliers or issue its own LOA.

6. AIRCRAFT MODIFICATIONS (DATABASE UPDATE)

If an aircraft system necessary for Basic-RNP 1 operations is modified (e.g., change of software), the operator is responsible for validating the Basic-RNP 1 procedures, SIDs, and STARs with the navigation database and the modified system. This can be done without any direct assessment if the manufacturer confirms that the modification has no effect on the navigation database or on path calculation. If there is no such confirmation by the manufacturer, the operator must perform an initial validation of the navigation data with the modified system.

APPENDIX 3**BASIC-RNP 1 APPROVAL PROCESS**

- a) The Basic-RNP 1 approval process consists of two types of approvals, airworthiness and operational. Although the two have different requirements, they must be considered in one single process.
- b) This process is an orderly method used by the CAA to make sure that the applicants meet the established requirements.
- c) The approval process is made up by the following phases:
 - 1) Phase one: Pre-application
 - 2) Phase two: Formal application
 - 3) Phase three: Documentation evaluation
 - 4) Phase four: Inspection and demonstration
 - 5) Phase five: Approval
- d) In *Phase one - Pre-application*, the CAA calls the applicant or operator to a pre-application meeting. At this meeting, the CAA informs the applicant or operator of all the operational and airworthiness requirements that it must meet during the approval process, including the following:
 - 1) the contents of the formal application;
 - 2) the review and evaluation of the application by the CAA;
 - 3) the limitations (if any) applicable to the approval; and
 - 4) conditions under which the Basic-RNP 1 approval could be cancelled.
- e) In *Phase two – Formal Application*, the applicant or operator submits the formal application along with all the relevant documentation, as established in Paragraph 9.1.1 b) of this AC.
- f) In *Phase three – Documentation evaluation*, the CAA evaluates all the documentation and the navigation system to determine their eligibility and the approval method to be followed in connection with the aircraft. As a result of this analysis and evaluation, the CAA may accept or reject the formal application along with the documentation.
- g) In *Phase four – Inspection and demonstration*, the operator will provide training to its personnel and will carry out the validation flight, if required.
- h) In *Phase five - Approval*, the CAA issues the Basic-RNP 1 approval once the operator has met the airworthiness and operational requirements. For LAR 121 and 135 operators, the CAA will issue the OpSpecs, and for LAR 91 operators, a LOA.

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BASIC-RNP 1 JOB AID

REQUEST TO CONDUCT BASIC-RNP 1 OPERATIONS

1. Introduction

This Job Aid was developed by the Latin American Regional Safety Oversight Cooperation System (SRVSOP) to provide States, operators, and inspectors with guidance on the process to be followed by an operator in order to obtain a Basic-RNP1 authorization.

2. Purpose of the Job Aid

- 2.1 To give operators and inspectors information on the main reference documents of Basic-RNP 1.
- 2.2 To provide tables showing the contents of the application, the associated reference paragraphs, the place in the application of the operator where Basic-RNP 1 elements are mentioned and columns for inspector comments and follow-up on the status of various elements of Basic-RNP 1.

3. Actions Recommended for the Inspector and Operator

Some recommendations for use of the Job Aid follow:

- 3.1 At the pre-application meeting with the operator, the inspector reviews the “basic events of the Basic-RNP 1 approval process ”described in Part 1 of this Job Aid, in order to provide an overview of the approval process events.
- 3.2 The inspector reviews this Job Aid with the operator in order to establish the form and content of the Basic-RNP 1 approval application.
- 3.3 The operator uses this Job Aid as a guide to collect the documents/annexes of the Basic-RNP 1 application.
- 3.4 The operator inserts in the Job Aid references showing in what part of its documents are the Basic-RNP 1 programme elements located.
- 3.5 The operator submits the Job Aid and the application to the inspector (documents/annexes).
- 3.6 The inspector indicates in the Job Aid whether an item is in compliance or needs corrective action.
- 3.7 The inspector informs the operator as soon as possible when a corrective action by the operator is required.
- 3.8 The operator provides the inspector with the revised material when so requested.
- 3.9 The CAA provides the operator with the operational specifications (OpSpecs) or a letter of authorisation (LOA), as applicable, when the tasks and documents have been completed.

4. Structure of the Job Aid

Parts	Topics	Page
Part 1	General information	3
Part 2	Information on aircraft and operator identification	5
Part 3	Operator application (Annexes and documents)	7
Part 4	Contents of the operator application for Basic-RNP 1	9
Part 5	Guide to determine the eligibility of Basic-RNP 1 aircraft	13
Part 6	Basic pilot procedures for Basic-RNP 1 operations	17

5. Main sources of documents, information, and contacts

To access the Basic RNP 1 Job Aid, enter to the Web page of the ICAO/SAM Regional Office (www.lima.icao.int) under the SRVSOP link.

6. Main reference documents

Reference Document	Title
Annex 6	Operation of aircraft
ICAO Doc 9613	Performance based navigation (PBN) manual
FAA AC 90-105 Appendix 2	Qualification criteria for RNP 1 (terminal) operations
AMC 20-5	Acceptable means of compliance for airworthiness approval and operational criteria for the use of the NAVSTAR Global positioning system (GPS)
AC 20-130A	Airworthiness approval of navigation or flight management systems integrating multiple navigation sensors
AC 20-138A	Airworthiness approval of Global navigation satellite system (GNSS) equipment
TSO-C115b	Airborne area navigation equipment using multi-sensor inputs
TSO-C129a	Airborne supplemental navigation equipment using the global positioning system (GPS)
TSO-C145a	Airborne navigation sensors using the global positioning system (GPS) augmented by the wide area augmentation system (WAAS)
TSO-C146a	Stand-Alone airborne navigation equipment using the global positioning system (GPS) augmented by the wide area augmentation system (WAAS)

PART 1: GENERAL INFORMATION**Basic events in the Basic-RNP 1 approval process**

	Action by the operator	Action by the CAA
1	Establishes the need to obtain Basic-RNP 1 authorization.	
2	Reviews the AFM, AFM supplement or Type Certificate Data Sheet (TCDS), or other appropriate documents (e.g., service bulletins (SB), service letters (SL), etc.) to determine the eligibility of the aircraft for Basic-RNP 1 operations. The operator contacts the aircraft or avionics manufacturer, if necessary, to confirm Basic-RNP 1 or higher eligibility of the aircraft.	
3	Contacts the CAA to schedule a pre-application meeting to discuss the operational approval requirements.	
4		During the pre-application meeting, establishes: <ul style="list-style-type: none"> • the form and contents of the application; • the documents that support Basic-RNP 1 approval • the date in which the application will be submitted for evaluation • if necessary, conducts a validation flight observed by the CAA.
5	Submits the application at least 60 days before start-up of Basic-RNP 1 operations.	
6		Reviews the request of the operator.
7	Once the amendments to manuals, programmes, and documents have been approved, provides training to flight crews, flight dispatchers, and maintenance personnel, and conducts a validation flight, if required by the CAA.	Only if required, participates in the validation flight.
8		Once the operational and airworthiness requirements have been met, issues the operational approval in the form of OpSpecs for LAR 121 or 135 or equivalent operators, or an LOA for LAR 91 or equivalent operators, as appropriate.

Notes related to the approval process**1. Responsible authority**

- a. **Commercial air transport (LAR 121 and/or 135 regulations or equivalent).**- The **State of Registry** determines that the aircraft meets the airworthiness requirements. The **State of the Operator** issues the Basic-RNP 1 approval (e.g., OpSpecs).
- b. **General Aviation (LAR 91 regulations or equivalent).**- The **State of Registry** determines that the aircraft meets the airworthiness requirements and issues the operational approval (e.g., an LOA).

2. The CAA does not need to issue an LOA or equivalent document for each individual area of operation in the case of LAR 91 operators.

3. LAR 121 and/or 135 operators with Basic-RNP 1 approval must list this approval in the OpSpecs.

4. Related sections of the Latin American Aeronautical Regulations (LAR) or equivalent regulations

- a. LAR 91 Sections 91.1015 and 91.1640 or equivalents
- b. LAR 121 Section 121.995 (b) or equivalent
- c. LAR 135 Section 135.565 (c) or equivalent

5. Related ICAO Documents

- a. Annex 6 to the Convention on International Civil Aviation – Operation of Aircraft
- b. Annex 10 to the Convention on International Civil Aviation – Aeronautical telecommunications
- c. Annex 15 to the Convention on International Civil Aviation – Aeronautical information services
- d. ICAO Doc 9613 – Performance-based navigation (PBN) manual
- e. ICAO Doc 4444 – Procedures for air navigation services – Air traffic management

PART 2: INFORMATION ON THE IDENTIFICATION OF AIRCRAFT AND OPERATORS

NAME OF THE OPERATOR: _____

Aircraft manufacturer, model, and series	Registration numbers	Serial numbers	Basic-RNP 1 system Number, manufacturer, and model	RNP specification

DATE OF PRE-APPLICATION MEETING _____

DATE ON WHICH THE APPLICATION WAS RECEIVED _____

DATE ON WHICH THE OPERATOR INTENDS TO BEGIN BASIC-RNP 1 OPERATIONS _____

IS THE CAA NOTIFICATION DATE APPROPRIATE? YES _____ NO _____

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PART 3 – OPERATOR APPLICATION (ANNEXES AND DOCUMENTS)

Annex	Title of Annex/Document	Indication of inclusion by the operator	Comments by the Inspector
A	Operator letter requesting Basic-RNP 1 authorization		
B	<p>Airworthiness documents showing aircraft eligibility for Basic-RNP 1.</p> <p>AFM, AFM revision, AFM supplement, or Type certificate data sheet (TCDS) showing RNP system eligibility for Basic-RNP 1 or less.</p> <p>Statement by the manufacturer.- Aircraft that have a statement by the manufacturer documenting compliance with SRVSOP CA 91-006 criteria or equivalent, meet the performance and functional requirements of said document.</p>		
C	<p>Aircraft modified to meet Basic-RNP 1 standards. Documentation on aircraft inspection and/or modification, if applicable. Maintenance records documenting the installation or modification of aircraft systems (e.g., FAA Form 337 – major repairs and alterations).</p>		
D	<p>Maintenance programme</p> <ul style="list-style-type: none"> • For aircraft with established Basic-RNP 1 system maintenance practices, the list of references of the document or programme. • For recently installed Basic-RNP1 systems, the maintenance practices for their review. 		
E	<p>Minimum equipment list (MEL) (only for operators conducting operations based on a MEL):</p> <p>MEL showing provisions for Basic-RNP 1 systems.</p>		
F	<p>Training</p> <p>1. LAR 91 operators or equivalent: Training method: Training at home, LAR 142 training centres, or other training courses, course</p>		

Annex	Title of Annex/Document	Indication of inclusion by the operator	Comments by the Inspector
	completion records. 2. LAR 121 and/or 135 operators or equivalent: Training programmes (training curricula) for flight crews, flight dispatchers, and maintenance personnel.		
G	Operating policies and procedures 1. LAR 91 operators or equivalent: Operations manual (OM) or sections to be attached to the application, corresponding to Basic-RNP 1 operating procedures and policies. 2. LAR 121 and/or 135 operators or equivalent: Operations manual and checklists.		
H	Navigation database Details of the navigation data validation programme.		
I	Withdrawal of Basic-RNP 1 approval Indication of the need to follow up on navigation error reports submitted and the possibility of withdrawal of Basic-RNP 1 approval.		
J	Validation flight plan: Only if required by the CAA.		

CONTENTS OF THE APPLICATION TO BE SUBMITTED BY THE OPERATOR

___ **BASIC-RNP 1 COMPLIANCE DOCUMENTATION OF THE AIRCRAFT/NAVIGATION SYSTEMS**

___ **OPERATING PROCEDURES AND POLICIES**

___ **SECTIONS OF THE MAINTENANCE MANUAL RELATED TO THE BASIC-RNP 1 SYSTEM (if not previously reviewed)**

Note 1: Documents may be grouped in a single folder or may be sent as individual documents.

PART 4: CONTENTS OF THE OPERATOR APPLICATION FOR BASIC-RNP 1 OPERATIONS

#	Contents of the Basic-RNP 1 application by the operator	Reference paragraphs CA 91-006	In what Annexes/Documents of the operator can the application contents be located Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	Operator request letter Statement of intent to obtain Basic-RNP 1 authorization.	Paragraph 9.1.1 b) 1) Appendix 3, Paragraph e)	Annex A		
2	Description of aircraft equipment.	Paragraph 9.1.1 b) 2)			
3	Eligibility of Basic-RNP 1 systems. Airworthiness documents establishing the eligibility of the Basic-RNP 1 navigation system, its approval status, and a list of the aircraft for which the approval is being requested.	Paragraph 9.1.1 b) 3) Paragraph 8.3	Annex B Annex C		
4	Training programme 1. LAR 121 or 135 operators or equivalent: Training programmes: Operators will develop an initial and periodic training programme for flight crews, flight dispatchers, if applicable, and maintenance personnel. 2. LAR 91 operators or equivalent: Training methods: The following methods are acceptable for these operators: Training at home, LAR 142	Paragraph 9.1.1 b) 4) (a) Paragraph 11 For maintenance, paragraph 9.1.1 b) 8) Paragraph 9.1.1 b) 4) (b) Paragraph 11	Annex F		

#	Contents of the Basic-RNP 1 application by the operator	Reference paragraphs CA 91-006	In what Annexes/Documents of the operator can the application contents be located Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	training centres, or other training courses.				
5	Operating procedures 1. LAR 121 and/or 135 operators or equivalent: Operations manual and checklists. 2. LAR 91 operators or equivalent: Operations manual or section of the operator application documenting Basic-RNP 1 policies and procedures.	Paragraph 9.1.1 b) 5) (a) Paragraph 10 Paragraph 9.1.1 b) 5) (b) Paragraph 10	Annex G		
6	Maintenance practices <ul style="list-style-type: none"> • For aircraft with established maintenance practices for Basic-RNP 1 navigation systems, the operator will provide document references. • For newly installed Basic-RNP 1 systems, the operator will provide maintenance practices for their review. 	Paragraph 8.5 b) Paragraph 9.1.1 b) 7)	Annex D		
7	Update of the minimum equipment list (MEL) Applicable to operators conducting operations according to a MEL.	Paragraphs 8.5 a) and 9.1.1 b) 6)	Annex E		
8	Navigation data validation programme	Paragraph 9.1.1 b) 9)	Annex F		

#	Contents of the Basic-RNP 1 application by the operator	Reference paragraphs CA 91-006	In what Annexes/Documents of the operator can the application contents be located Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
9	Withdrawal of Basic-RNP 1 approval Indication of the need for follow-up on the navigation error reports and the possibility of withdrawal of the Basic-RNP 1 approval.	Paragraph 13	Annex H		
10	Validation flight plan, only if required The validation flight plan will be presented only if required.	Paragraph 9.1.1 d)	Annex I		

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PART 5 – GUIDE TO DETERMINE THE ELIGIBILITY OF BASIC-RNP 1 AIRCRAFT

#	Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	<p>Aircraft eligibility requirements for Basic-RNP 1 operations in terminal area RNP systems that use GNSS data input.</p> <p>The following systems installed in the aircraft meet the requirements defined in AC 91-006. This equipment requires evaluation by the manufacturer and operator against all the functional and performance requirement established in that AC:</p>	Paragraph 8.1.3	Annex B		
1a	Aircraft with E/TSO-C129a Class A1 system or E/TSO-C146 () system installed for use of IFR according to FAA AC 20-138 or AC 20-138A	Paragraph 8.1.3 a)			
1b	Aircraft with E/TSO-C129a sensor (Class B or C) installed in a flight management system (FMS) that meets TSO-C115b requirements and is installed for use of IFR according to FAA AC 20-130A	Paragraph 8.1.3 b)			
1c	Aircraft with E/TSO-C145 () sensor installed in an FMS that meets TSO-C115b requirements and is installed for use of IFR according to FAA AC 20-130A or AC 20-138A	Paragraph 8.1.3 c)			

#	Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1d	Aircraft with RNP capability certified or approved with equivalent standards.	Paragraph 8.1.3 d)			
2	Performance, control, and alerting requirements	Paragraph 8.1.2	Annex B		
3	Aircraft and systems eligibility for Basic-RNP 1 operations in terminal area 1. Aircraft with a statement of compliance with SRVSOP CA 91-006 requirements or equivalent document 2. Aircraft with a statement by the manufacturer 3. Modified aircraft. 4. Stand-alone GNSS systems must be approved according to E/TSO-C129a Class A1 or E/TSO-C146 and operational Class 1, 2 or 3 (with no deviation from the functional requirements described in the AC 91-006), and installed for IFR use in accordance with AC 20-138A. 5. Aircraft with E/TSO-C129a sensor(s) Class B or C or E/TSO-C145 sensor(s) and FMS that meet E/TSO-C115b requirements and are installed for IFR use according to FAA AC 20-130A 6. Aircraft/equipment approved under SRVSOP CA 91-003 or equivalent	Paragraph 8.3 Paragraph 8.3.1 Paragraph 8.3.2 Paragraph 8.3.3 Paragraph 8.3.4 Paragraph 8.3.5 Paragraph 8.3.6	Annex B		

#	Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	<p>(e.g., FAA AC 90-100A) for use of GNSS, are approved for Basic-RNP 1 operations under this CA.</p> <p>7. RNP aircraft with P-RNAV approval based on GNSS capability meet the functional requirements of this AC for Basic-RNP 1 operations, such as SIDs y STARs. The GNSS system approved according to E/TSO-C129 and satisfying the step-detection and health word checking contained in E/TSO-C129A, meets P-RNAV performance requirements.</p>	Paragraph 8.3.7			
5	Functional requirements and their explanation	Paragraph 8.4 Appendix 1	Annex B		
6	Maintenance requirements	Paragraph 8.5	Annex B		
7	Navigation database Details of the navigation data validation programme	Paragraph 12 Appendix 2	Annex B		

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PART 6 - BASIC PILOT PROCEDURES FOR BASIC-RNP 1 OPERATIONS

Topics		Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
Operating procedures		Paragraph 10	Annex G		
1	Pre-flight planning	Paragraph 10.1 a)			
	Operators and pilots intending to conduct Basic-RNP 1 SIDs and STARs must fill out the appropriate boxes in the ICAO flight plan.	Paragraph 10.1 a) 1)			
	On-board navigation data must be current and include appropriate procedures.	Paragraph 10.1 a) 2)			
	The availability of the NAVAID infrastructure required for the intended routes, including any non-RNP contingency, must be confirmed for the period of intended operations, using all available information. Since Annex 10 Volume I requires GNSS integrity (RAIM or SBAS), it is also necessary to confirm appropriate availability of these devices. For aircraft that navigate with SBAS receivers [all TSO-C145 () / C146 () receivers], operators shall confirm appropriate availability of the GNSS RAIM in areas where the SBAS signal is not available.	Paragraph 10.1 a) 3)			
	RAIM (ABAS) availability	Paragraph 10.1 a) 4)			
2	General operating procedures	Paragraph 10.1 b)			

Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
The pilot shall comply with any instruction or procedure identified by the manufacturer, as necessary, to meet the performance requirements of this section.	Paragraph 10.1 b) 1)			
Operators and pilots shall not request or file Basic-RNP 1 routes, SIDs or STARs, unless they meet all the criteria set forth in this AC. If an aircraft that does not meet these criteria and is cleared by the ATC to conduct a Basic-RNP 1 procedure, the pilot will notify the ATC that it cannot accept such clearance and will request alternate instructions;	Paragraph 10.1 b) 2)			
At system initialization, pilots must: (a) confirm that the navigation database is current; (b) verify that the aircraft position has been entered correctly; (c) verify the appropriate entry of the assigned ATC route once they receive the initial clearance, and of any subsequent change in route; and (d) ensure that the sequence of WPTs as depicted in their navigation system matches the route drawn in the appropriate charts and the assigned route.	Paragraph 10.1 b) 3)			
Pilots shall not fly a Basic-RNP 1 procedure, unless it can be retrievable from the on-board	Paragraph 10.1 b) 4)			

Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
<p>navigation database by its name, and conforms with the procedure in the chart. However, the procedure can be modified afterwards by inserting or deleting specific WPTs in response to ATC clearance. Manual entry or the creation of new WPTs through manual insertion of latitude and longitude or rho/theta values is not permitted. Likewise, pilots must not change any type of WPT from a fly-by WPT to a flyover WPT or <i>vice versa</i>.</p>				
<p>Flight crews shall cross-check the cleared flight plan by comparing charts or other applicable resources to the navigation system text displays and aircraft map displays, as applicable. If required, the exclusion of specific NAVAIDs must be confirmed. A procedure shall not be used if there are any doubts about the validity of the procedure in the navigation database.</p>	Paragraph 10.1 b) 5)			
<p>A cross-check is not required for conventional NAVAIDs, since the absence of integrity alert is considered sufficient to meet integrity requirements. However, it is suggested that the navigation reasonableness be checked, and any loss of RNP capability must be reported to the ATC.</p>	Paragraph 10.1 b) 6)			
<p>For Basic-RNP 1 procedures, pilots must use a lateral deviation indicator, an FD or an AP in lateral navigation mode (LNAV). Pilots of aircraft with a lateral deviation display must make sure that the lateral deviation scale is appropriate for the navigation precision associated to the</p>	Paragraph 10.1 b) 7)			

Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
route/procedure (e.g., full-scale deflection: ± 1 NM for Basic-RNP 1).				
All pilots are expected to follow the route centreline, as represented on the on-board lateral deviation indicators and/or flight guidance, during all Basic-RNP 1 operations, unless cleared by the ATC to deviate or due to an emergency. For normal operations, the cross-track error/deviation (the difference between the path estimated by the RNP system and the position of the aircraft relative to the path, e.g. FTE) must be limited to $\pm \frac{1}{2}$ the navigation precision associated with the procedure (e.g., 0.5 NM for basic RNP 1). Small lateral deviations from this requirement are allowed (e.g., overshooting or undershooting the path) during or immediately after a turn, up to a maximum of 1 times the navigation precision (1xRNP) (e.g., 1 NM for basic RNP 1).	Paragraph 10.1 b) 8)			
If the ATC issues a course assignment that places the aircraft out of the route, the pilot shall not modify the flight plan in the RNP system until a new clearance is received allowing the aircraft to return to the route or until the controller confirms a new route clearance. When the aircraft is not on the published Basic-RNP 1 route, the specified precision requirements do not apply.	Paragraph 10.1 b) 9)			
Manual selection of functions that limit the banking angle of the aircraft can reduce the ability of the aircraft to maintain its desired track and is not	Paragraph 10.1 b) 10)			

Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
recommended. Pilots should acknowledge that manual selection of functions that limit the banking angle of the aircraft could reduce their ability to meet ATC path expectations, especially when turns with large banking angles are performed. This cannot be construed as a requirement to deviate from AFM procedures. Pilots must be encouraged to select such functions only within accepted procedures.				
Pilots operating aircraft that have a barometric vertical navigation system (baro-VNAV) can continue using said system while conducting Basic-RNP 1 SID and STAR procedures. Operators must ensure compliance with all altitude limitations, as published in the procedure, using the barometric altimeter as reference. Use of the barometric vertical navigation capability of the aircraft will be subject to the level of familiarisation and training of the flight crew, and on any other operational approval requirement.	Paragraph 10.1 b) 11)			
<p>Before starting a Basic-RNP 1 procedure, flight crews must:</p> <p>a) confirm that the correct procedure has been selected. This process includes checking WPT sequence, the reasonableness of track angles, distances, and any other parameter that can be modified by the pilot, such as altitude or speed limitations; and</p> <p>b) for multi-sensor systems, check that the correct</p>	Paragraph 10.1 b) 12)			

	Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	sensor is being used for position computation.				
3	Aircraft with RNP selection capability Pilots of aircraft capable of selecting RNP input must select RNP 1 or lower for Basic-RNP 1 SIDs, STARs or procedures.	Paragraph 10.1 c)			
4	Basic-RNP 1 SID specific requirements	Paragraph 10.1 d)			
	Before beginning take-off, the pilot must verify that the airborne Basic-RNP 1 system is available and operating correctly, and that the appropriate aerodrome and runway data have been loaded. Before the flight, pilots must verify that the airborne navigation system is operating correctly and that the appropriate runway and departure procedure (including any applicable en-route transition) have been loaded and are properly displayed. Pilots assigned to a Basic-RNP 1 departure procedure and subsequently receive a change of runway, procedure or transition, must verify that the appropriate changes have been entered and are available for navigation before take-off. A final check of proper runway entry and correct route depiction, shortly before take-off, is recommended.	Paragraph 10.1 d) 1)			
	<i>Altitude for engagement the RNAV equipment.</i> The pilot must be capable of connecting the RNP equipment in order to follow the flight guidance in the RNP lateral navigation mode before reaching 153 m (500 ft) above the aerodrome elevation.	Paragraph 10.1 d) 2)			

	Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	Pilots must use an authorised method (lateral deviation indicator/navigation map display/FD/AP) to achieve an appropriate level of performance for Basic-RNP 1.	Paragraph 10.1 d) 3)			
	<i>GNSS aircraft.</i> - When a GNSS is used, the signal must be obtained before starting the take-off roll. For aircraft using E/TSO-C129a equipment, the take-off aerodrome must be loaded into the flight plan in order to achieve the appropriate navigation system monitoring and sensitivity. For aircraft using E/TSO-C145 ()/C146 () equipment, if the departure starts at a runway waypoint (WPT), then the departure aerodrome does not need to be in the flight plan in order to obtain the appropriate monitoring and sensitivity mentioned above. If a Basic-RNP 1 SID extends beyond 30 NM from the aerodrome and a lateral deviation indicator is used, its full-scale sensitivity must be set to a value not greater than 1 NM between 30 NM from the aerodrome and the termination of the Basic-RNP 1 SID.	Paragraph 10.1 d) 4)			
	For aircraft using a lateral deviation display (e.g., a navigation map display), the scale must be adjusted for the Basic-RNP 1 SID and FD or AP must be used.	Paragraph 10.1 d) 5)			
5	Basic-RNP 1 STAR specific requirements	Paragraph 10.1 e)			
	Before the arrival phase, the flight crew shall verify	Paragraph 10.1 e) 1)			

Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
<p>that the correct terminal route has been loaded. The active flight plan shall be checked, comparing the charts to the map display (if applicable) and the multi-function control display unit (MCDU). This includes confirmation of WPT sequence, the reasonableness of track angles and distances, any altitude or speed constraints, and, whenever possible, which are fly-by WPTs and which are flyover WPTs. If required by a route, a check will need to be made to confirm that updating will exclude a particular NAVAID. A route will not be used if there are doubts about its validity in the navigation database.</p>				
<p>The creation of new WPTs by the flight crew through manual entries into the Basic-RNP 1 system will invalidate any route, and is not permitted.</p>	Paragraph 10.1 e) 2)			
<p>When contingency procedures require reverting to a conventional arrival route, the flight crew must make the necessary preparations before starting the Basic-RNP 1 procedure.</p>	Paragraph 10.1 e) 3)			
<p>Modification made to a route in the terminal area may take the form of radar headings or "direct to" clearances. In this sense, the flight crew must be capable of reacting in time. This may include the insertion of tactical WPTs loaded from the database. The flight crew is not allowed to make manual entries or to modify a loaded route, using temporary WPT or fixes not provided in the</p>	Paragraph 10.1 e) 4)			

Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
database.				
Pilots must verify that the aircraft navigation system is operating properly and that the correct arrival procedure and runway are properly entered and displayed.	Paragraph 10.1 e) 5)			
Although a particular method is not mandated, any published altitude and speed constraints must be observed.	Paragraph 10.1 e) 6)			
Aircraft with E/TSO-C129a GNSS RNP systems: If a Basic-RNP 1 STAR begins beyond 30 NM from the aerodrome and a lateral deviation indicator is used, its full-scale sensitivity must be set to a value not greater than 1 NM before commencing the STAR. For aircraft that use a lateral deviation display (e.g., a navigation map display), the scale must be adjusted to the Basic-RNP 1 STAR and the FD or AP must be used.	Paragraph 10.1 e) 7)			
6 Contingency procedures	Paragraph 10.1 f)			
The pilot must notify the ATC of any loss of RNP capability (integrity alerts or loss of navigation), together with the proposed course of action. If, for any reason, it is not possible to meet the requirements of a Basic-RNP 1 SID or STAR, pilots must notify the ATS as soon as possible. Loss of RNP capability includes any failure or event that causes the aircraft to be unable to meet the Basic-	Paragraph 10.1 f) 1)			

Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
RNP 1 requirements of the route.				
In case of a communication failure, the flight crew must continue with the established procedure for loss of communication.	Paragraph 10.1 f) 2)			

SRVSOP contacts:

Marcelo Ureña Logroño: SRVSOP Safety oversight specialist/aircraft operations

e-mail: murena@lima.icao.int

Job Aid: Basic-RNP 1
 Version: Original
 Date: 12/10/2009

Agenda Item 4: Air Traffic Flow Management Implementation (ATFM) in the SAM Region

Implementation of Air Traffic Flow Management (ATFM) in the SAM Region

4.1 The Meeting noted that in 2012, only 21% of SAM States had made capacity calculations. In 2013, 57% of States have made the corresponding capacity calculations, an increase by 36%. Regarding the implementation of flow management units or positions, only 14% of the States had attained this goal in 2012. In 2013, 35% of the States have met the goal. The next table illustrates the evolution of implementation during the 2012-2013 period:

Percentage of States that have done runway and ATC sector capacity calculations

	ARG	BOL	BRA	CHI	COL	FGY	ECU	GUY	PAN	PAR	PER	SUR	URU	VEN
2012														
21%	NO	NO	YES	NO	NO	N/A	YES	NO	NO	NO	NO	NO	NO	YES
2013														
57%	YES	YES	YES	YES	YES	N/A	NO	NO	NO	YES	YES	NO	NO	YES

4.2 Likewise, the Secretariat informed that ICAO intends to post regional efficiency graphs on the public website of each of its Regional Offices, showing the regional status of implementation of the strategic objectives of the Organization for the 2014-2016 period, and showing the efficiency indicators foreseen for the Region.

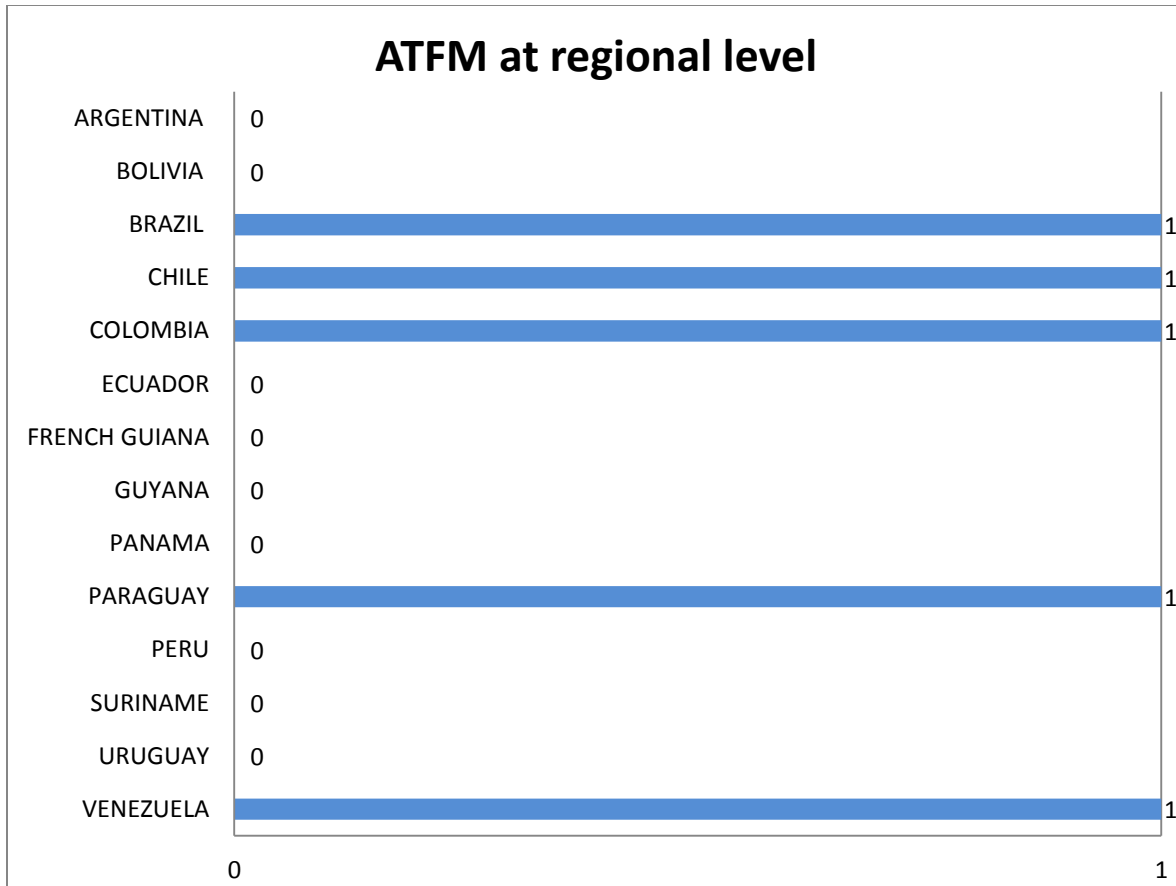
4.3 This information will help the PIRGs and the States to determine the areas that require special attention in order to improve the efficiency of air navigation worldwide. The first publication of this report is scheduled for April 2014.

4.4 To date, 2 centralised flow management units and 3 flow management units or positions (FMU/FMP) have been implemented in the SAM Region, one State is in the process of implementation, and 8 States are starting activities or have not taken any action for the implementation of ATFM.

4.5 The analysis revealed that 36% of SAM States have implemented FMUs or FMPs. The figure below shows the status of implementation of ATFM and the States that have started taking steps to implement FMUs/FMPs. The table below shows the evolution between 2012 and 2013.

Percentage of States that have implemented ATFM at flow management units (FMUs) or flow management positions (FMPs)

	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN
2012														
14%	NO	NO	YES	NO	YES	NO	N/A	NO	NO	NO	NO	NO	NO	NO
2013														
36%	NO	NO	YES	YES	YES	NO	N/A	NO	NO	YES	NO	NO	NO	YES



4.6 Out of a total of 99 international airports in the SAM Region, the ATFM service is provided at 51 airports (27 in Brazil, 8 in Colombia, 7 in Chile, 2 in Paraguay, and 7 in Venezuela), accounting for 52% of the total number of airports in the Region. This percentage does not include airports in States that are in process of implementation. See table below:

Total number of airports	Airports with ATFM service	% airports with ATFM service
99	50	52 %

4.7 The Meeting updated the Action Plan for the Implementation of ATFM shown in **Appendix A** to this part of the Report, based on State plans, and in **Appendix B**, airports in which runway and/or ATC sector capacity has been calculated, were individualised.

4.8 The Meeting updated the ATFM focal points list as shown in **Appendix C**.

ATFM matters for future SAM/IG meetings

4.9 The Meeting took note that the ATFM *ad hoc* group had deemed it convenient that future meetings address the following topics for the ATFM implementation process in the SAM Region:

- a) Improve traffic flow through runway sequencing (AMAN-DMAN) - B0-15 or B0-rseq), taking into account the importance of ensuring interoperability between ATFM automated systems and these sequencing tools.
- b) Improve airport operations through CDM at the level of the airport (B0-80 or B0-CDM), taking into account that A-CDM means collaboration among all those involved in the airport rotation process, among ATCs, airlines, ground handling agents, and the airport operator, with emphasis on:

The relationship between arrival, rotation, and departure processes:

- sharing of the right information, at the right time, with the right people, in order to act accordingly.
- improved real-time exchange of data between airports and the ATFM network.

- c) Meteorological information to support safety improvement and efficiency (B0-105 or B0-AMET), taking into account the importance of improving predictability of adverse weather conditions affecting airport and airspace capacity required to implement ATFM initiatives to regulate traffic based on such conditions.
- d) More efficient flow management through planning based on a network-wide vision (B0-35 or B0-NOPS). In order to ensure demand/capacity balancing, ATFM units must be able to monitor demand throughout the airspace system, applying ATFM initiatives that address imbalances in the different ATC sectors and airports that could affect others.

ATFM training

4.10 The Meeting took note of the request made by the States of the Region to organise the A-CDM course with the support of Project RLA/06/901, in accordance with that established by ICAO and the SAM ATFM Implementation Plan concerning the CDM concept.

4.11 Regarding the above, it was felt advisable for States to designate the proper personnel to participate in the 5-day course offered by IATA, to be held at the Command Center, Washington - USA, if possible in March 2014.

4.12 Likewise, the Meeting entrusted the Secretariat with requesting Project RLA/06/901 to support the holding of the A-CDM course. This course shall contemplate the following aspects:

- a) Adjustment of airport CDM objectives;
- b) Implementation process;
- c) General considerations;
- d) Exchange of information;
- e) Planning milestones;
- f) Calculation of taxi time variables;
- g) Collaborative management of flight updates using ATFM;
- h) Collaborative sequencing;

- i) CDM for adverse conditions and operational constraints; and
- j) Measurement of post-implementation success.

4.13 For this course, one fellowship is requested per State, and the participation of additional personnel to the Airport CDM course will depend on the possibilities of each State.

4.14 The Meeting took note of the request for assistance from Project RLA/06/901 for the conduction of a 10-day theoretical/practical course on ATFM procedures to be conducted by appropriate personnel from the States at the CGNA of Brazil, if possible during the second half of 2014.

4.15 This course shall cover the following aspects:

- a) Airspace monitoring aspects;
- b) Air traffic demand analysis processes;
- c) ATFM standards and procedures for an FMU/FMP unit;
- d) Application of preliminary ATFM measures;
- e) Application of TMI;
- f) ATFM messaging;
- g) International teleconferences;
- h) Coordination of special events;
- i) Civil/military coordination processes; and
- j) ATFM exemption procedures.

4.16 For this course, the following profile shall be considered:

- a) Air traffic controllers that have participated in training courses on ATFM, CDM, airport and ATC sector capacity calculation or who have been involved in ATFM implementation and development processes in their State.

4.17 For this course, one fellowship is requested per State, and the participation of additional personnel to the Airport CDM course will depend on the possibilities of each State.

Operational agreements

4.18 The Meeting took note that the ATFM *ad-hoc* group would carry out the corresponding activities to reach the relevant ATFM operational agreements to be signed at the SAM/IG/13 meeting, using the format proposed by Colombia, as shown in **Appendix D** to this part of the report.

4.19 Likewise, it was deemed of great importance for the SAM/IG/13 meeting to discuss the status of implementation of the SAM ATFM action plan, taking into account the relevance of ATFM for the special events foreseen for 2014, namely the World Cup and the 2016 Olympics to be held in Brazil, which will impact the SAM Region as well as other adjacent regions.

4.20 Argentina, Brazil, Colombia, Ecuador, Paraguay, and Peru will present information papers describing the progress made with respect to the SAM Action Plan.

ATFM teleconferences

4.21 Regarding telecommunications, the Meeting took note of the plans to conduct weekly teleconferences on ATFM through ICAO/IATA, the first scheduled for 31 October at 15:00 UTC.

4.22 Furthermore, the ATFM database (required by the States according to their needs, level of implementation, and equipment available) will be sent to automation experts for coordination and improvement of requirements. The guide provided by Colombia was adopted.

4.23 The Meeting was apprised by the LAN Airlines Group of the importance of harmonising and standardising concepts in the Region, since member States had attained different levels. The primary objective of the ATFM Group was for everybody to reach the same level of implementation and thus satisfy all operators.

4.24 The Meeting welcomed the report on the level of ATFM implementation reached in Paraguay, as shown in **Appendix E** to this part of the report.

Automated systems – Preliminary database requirements

4.25 The preliminary database requirements presented by Colombia are shown in **Appendix F**. These requirements shall be analysed by the ATFM Group and the Automation Group at the next meeting.

APPENDIX A

ACTION PLAN FOR THE IMPLEMENTATION OF ATFM AT SAM AIRPORTS

A: AIRPORT				
Task description	Start	End	Responsible party (designate individual or organisation in charge)	Remarks
1. Airport demand/capacity (runway capacity) analysis				
1.9 Carry out Calculation of Airport and Airspace Capacity of main airports by States. 1. Identify personnel available in each State to carry out calculation of runway capacity. 2. Identify which airports already have calculation of runway capacity. 3. Identify, prioritize and report what airports require calculation of runway capacity. 4. Carry out calculation of runway capacity. 5. Identify airports exceeding runway capacity.	Sep 2009	SAM/IG/14	States	<p style="text-align: center;">Valid</p> States that have not yet done so are encouraged to submit the required information. Item 4 has to be presented to SAM/IG/14.
1.10 Notify the airports where periods exist where the demand is greater than existing capacity including simulations, if necessary, by States.	Sep/Oct 2009	Permanent	States	<p style="text-align: center;">Permanent</p> Brazil, Paraguay and Peru presented the data. Assure States that the aim of these tasks is to share information.
1.11 Determine operational factors affecting airport demand and capacity to optimise utilisation of existing capacity, including simulations, is necessary.	Sep/Oct 2009	Permanent	States	<p style="text-align: center;">Valid</p> Brazil, Paraguay and Peru presented the data.
1.13 Notify airport capacity in terms of aircraft operation in main airports.	SAM/IG/12		States	<p style="text-align: center;">Permanent</p> Updated in each SAM/IG.

A: AIRPORT				
Task description	Start	End	Responsible party (designate individual or organisation in charge)	Remarks
2. Coordination with the ATM community				
2.3 Promote seminars to the ATFM community considering the CDM concept for the implementation of ATFM and initiate corresponding coordination. 1. Consider the implementation of a CDM process in main airports. 2. States will notify airports with this process.	SAM/IG/11	Permanent	States	Valid ATFM operational concept, ATFM manual and ATFM roadmap will be taken into account.
3. Infrastructure and database				
3.2 Establish a data base format to be used for automation.	SAM/IG/11		States	Valid
4. Policy, standards, and procedures				
4.7 Ask States to submit AIP/AIC published information on ATFM. 1. Standardize this information. 2. Update the information.	SAM/IG/11		States	Permanent Information will be presented in each SAM/IG
5. Training				
5.1 Draft ATFM training plans and submit them.	SAM/IG/11		States	Permanent
5.2 Establish courses on: a) Training in FMP/FMU b) Training in airport CMD	SAM/IG/14		Project RLA/06/901	
5.6 Train FMP/FMU staff for application of ATFM measures for airports.	SAM/IG/11		States	Permanent
5.7 Monitor the training of the ATM community.	SAM/IG/11		States	Permanent

A: AIRPORT				
Task description	Start	End	Responsible party (designate individual or organisation in charge)	Remarks
6. Final implementation decision				
6.1 Review factors that may affect the implementation decision.			States	Valid
6.2 Declare the pre-operational implementation in the defined area.			States	Valid
6.3 Declare the final operational implementation in the defined area.			States	Valid
7. Monitor system performance				
7.1 Develop performance indicators according to CDM manual.	SAM/IG/11	SAM/IG/14	States	Valid States will present an information paper concerning the performance indicators.
7.2 Develop a performance indicators follow-up programme	SAM/IG/11		States	Valid
7.3 Develop and implement an ATFM post-implementation follow-up programme at airports.	SAM/IG/13	SAM/IG/15	States	Valid

ACTION PLAN FOR ATFM IMPLEMENTATION IN THE SAM REGION				
B- AIRSPACE (ATC Sector)				
Task description	Start	End	Responsible party (designate individual or office in charge)	Remarks
1. Airspace demand and capacity analysis				
1.2 Carry out ATC sectors calculation. 1. Identify personnel available in each State to carry out calculation of air space capacity. 2. Identify which sectors already count with calculation of	SAM/IG/11	SAM/IG/13	States	Permanent States that have not yet done so are encouraged to submit the required information.

ACTION PLAN FOR ATFM IMPLEMENTATION IN THE SAM REGION				
B- AIRSPACE (ATC Sector)				
Task description	Start	End	Responsible party (designate individual or office in charge)	Remarks
capacity. 3. Identify, prioritize and report what sectors require calculation of capacity. 4. Identify sectors exceeding capacity.				
1.4 Carry out the States estimate airspace ATC sector capacity calculation and their terminal areas at the major airports.	Sep 2009	SAM/IG/13	States	Valid
1.5. Identify airspace sectors where demand sometimes exceeds capacity, including simulations by the States, if necessary.	TBD		States	Permanent Brazil has presented their studies.
1.6 Identify factors affecting airspace demand and capacity in order to optimise the use of existing capacity, including simulations if necessary.	TBD		States	Permanent Brazil has presented their studies.
1.7 Present conclusions on the existing airspace capacity.	TBD		States	Permanente Brazil has presented their studies.
2. Coordination with the ATM community				
2.2 Promote seminars to the ATFM community considering the airspace capacity concept for the implementation of ATFM and initiate corresponding coordination.	SAM/IG/11		States	Valid
3. Infrastructure and database				
3.1 The ATFM/IG Group will present the basic requirements for a regional automated system.	SAM/IG/12	SAM/IG/13	ATFM/IG	Valid Brazil has already implemented. Colombia presented their preliminary requirements.

ACTION PLAN FOR ATFM IMPLEMENTATION IN THE SAM REGION				
B- AIRSPACE (ATC Sector)				
Task description	Start	End	Responsible party (designate individual or office in charge)	Remarks
3.2 Coordinate implementation activities with the Automation Group.	SAM/IG/13		ATFM/IG	Valid Depends on information of 3.1.
4. Policy, standards, and procedures	TBD	Jun 2013	States	
4.2 Develop a regional strategy and framework for the implementation of Centralized ATFM units.	2008	2014	Project RLA/06/901	Valid
4.3 Develop template/contents for operational agreements between Centralized ATFM units for interregional demand/capacity balancing.	2008	2014	Project RLA/06/901	Valid
4.4 Define common elements of situational awareness between FMUs; <ul style="list-style-type: none"> • common traffic displays; • common weather displays (Internet); • communications (teleconferences, web): 	2008		States	Permanent
4.5 Review the regional ATFM implementation roadmap to be used by States as FMU/FMP implementation guide.	SAM/IG/11	Permanent	States	Valid
4.6 Develop a regional strategy to implement the use of a flexible upper airspace (FUA): <ul style="list-style-type: none"> • evaluate the management processes in the use of the airspace; • improve the current domestic airspace management to adjust dynamic changes to the traffic flows in tactical stages; • introduce improvements to the ground ATS systems and associated procedures for the extension of the FUA with dynamic management processes in the use of the airspace; 	2008	2015	Project RLA/06/901	Valid

ACTION PLAN FOR ATFM IMPLEMENTATION IN THE SAM REGION				
B- AIRSPACE (ATC Sector)				
Task description	Start	End	Responsible party (designate individual or office in charge)	Remarks
<ul style="list-style-type: none"> dynamically implement ATC sectorization with the aim of providing a better balance between demand and capacity that responds in real time to changing situations in the traffic flows and to accommodate in the short-term the users preferred trajectories. 				
5. Training	TBD	TBD		
5.3 Train personnel in the sector capacity calculation and subjects related to ATFM for the airspace.	TBD	TBD	States	Permanent
5.4 Prepare plans and ATFM training material	TBD	TBD	States	Valid
5.5 Conduct training of personnel involved.	TBD	TBD	States	Valid
6. Final implementation decision				
6.1 Analyse factors affecting the implementation decision.	N/A		States	Valid
6.2 Declare pre-operational implementation in the area defined.	N/A		States	Valid
6.3 Declare definitive operational implementation in the area defined.	N/A		States	Valid
7. Monitor system performance				
7.1 Draft performance indicators	2010		Project RLA/06/901	Valid
7.2 Develop an indicators follow-up programme.	TBD		States	Valid

APÉNDICE B / APPENDIX B**CÁLCULO DE CAPACIDAD DE PISTA Y SECTORES ATC EN LOS PRINCIPALES
AERÓDROMOS DE LA REGIÓN SAM COMO PARTE DEL PLAN DE IMPLEMENTACIÓN
ATFM****ATC SECTORS AND RUNWAY CAPACITY CALCULATION IN THE MAIN AIRPORTS OF
THE SAM REGION AS PART OF THE ATFM IMPLEMENTATION PLAN**

Estado/ State	Lista de aeródromos con cálculo de capacidad de pista realizado / List of airports with runway capacity calculation carried out	Lista de Unidades ATC con cálculo de capacidad de sectores ATC realizado / List of ATC units with ATC sectors capacity calculation carried out	Información en AIP / AIP information
ARGENTINA	1	Ninguna/None	NO
BOLIVIA			
BRASIL/ BRAZIL	Ver Apéndice B1/See Appendix B1	Ver Apéndice B1/See Appendix B1	SI/YES
CHILE	1.-Aeropuerto Arturo Merino Benítez, Santiago 2.-Aeropuerto Cerro Moreno, Antofagasta	1 Centro de Control de Área Santiago (ACCS)	SI/YES
COLOMBIA	1	1	SI/YES
ECUADOR	2	2	NO
GUYANA FRANCESA/ FR. GUIANA			
GUYANA			
PANAMÁ	1	2	NO

Estado/ State	Lista de aeródromos con cálculo de capacidad de pista realizado / List of airports with runway capacity calculation carried out	Lista de Unidades ATC con cálculo de capacidad de sectores ATC realizado / List of ATC units with ATC sectors capacity calculation carried out	Información en AIP / AIP information
PARAGUAY	2	1	SI/YES
PERÚ	2	2	SI/YES
SURINAME			
URUGUAY			
VENEZUELA	3	1 ACC 3 TMA	SI/YES

CINDACTA III																			
SBPS				SBSV				SBRF				SBTE				SBIL			
16				25				29				12				15			
CINDACTA IV																			
SBBE				SBBV				SBEG				SBPV				SBSL			
20				21				25				21				20			
CINDACTA IV																			
SBRB																			
24																			
SRPV-SP																			
SBSP				SBGR				SBKP				SBRJ				SBGL			
34				47				28				29				40			
SRPV-SP																			
SBMT				SBJR															
33				31															

APÉNDICE C / APPENDIX C**LISTA DE CONTACTOS PARA PUNTOS FOCALES ATFM Y DE LAS UNIDADES ATFM ESTABLECIDAS /****LIST OF CONTACTS FOR ATFM FOCAL POINTS AND ESTABLISHED ATFM UNITS**

Estado/ State	Responsable ATFM-Nombre, FMU/ACC, correo electrónico, teléfono / ATFM responsible-Name, MU/ACC, e-mail, telephone
ARGENTINA	<p>Víctor Marcelo de Virgilio Jefe de Departamento Gestión del Espacio Aéreo Tel.: +5411 4317-6000, Ext 15130 Cel: E-mail: marcelodevirgilio4@gmail.com.ar</p> <p>Carlos Omar Torres Administración Nacional de Aeronáutica Civil (ANAC) Jefe Departamento Programación Técnica Tel: +54 11 5941-3000, Ext. 69193 E-mail: ctorres@anac.gov.ar</p>
BOLIVIA	<p>Miguel Castillo Jefe de la Unidad ATM/SAR Tel.: +591 2211-4465 Cel.: +591 7204-6745 E-mail: mcastillo@dgac.gob.bo</p> <p>Daniel Bustamante Inspector ATM/SAR Tel.: Cel.: 591-7220-1865 E-mail: dbustamante@dgac.gob.bo</p>
BRASIL / BRAZIL	<p>Centro de Gerenciamento e Navegação Aérea – CGNA Ten. Cel. Ricardo de Brito e Maj James Short Rio de Janeiro – Brasil Tel/Fax: +5521 2101-6747 e +5521 2101-6409 E-mail: ricardo@cgna.gov.br, e shortjss@cgna.gov.br</p> <p>1-CGNA – Salão Operacional. Gerente Nacional de Fluxo Rio de Janeiro - Brasil Tel/Fax: +5521 2101-6449 E-mail: dcc@cgna.gov.br</p>

Estado/ State	Responsable ATFM-Nombre, FMU/ACC, correo electrónico, teléfono / ATFM responsible-Name, MU/ACC, e-mail, telephone
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COLOMBIA	<p>Mauricio José Corredor Monroy Centro Nacional de Aeronavegación – Aeropuerto Internacional El Dorado Bogotá-Colombia E-mail: mauricio.corredor@aerocivil.gov.co</p>
ECUADOR	<p>Pedro William Plaza Muñoz Tel.: +5932 228-2851 Cel.: +5939 9819-9007 E-mail: pedro.plaza@dgac.gob.ec</p> <p>Galo Efraín Cevallos Alomía Tel.: +5932 254-9814 Cel.: +5939 9251-6822 E-mail: ams_transitoaereo@dgac.gob.ec</p> <p>Luis Marcelo Valencia Taco DGAC Quito Tel.: +5932 254-9814 Cel.: +5939 98350 6507 E-mail: marcelo_valencia@aviacioncivil.gob.ec</p>
GUYANA FRANCESA / FR.GUIANA	
GUYANA	

Estado/ State	Responsable ATFM-Nombre, FMU/ACC, correo electrónico, teléfono / ATFM responsible-Name, MU/ACC, e-mail, telephone
PANAMÁ	<p>Arsenio Bethancourt</p> <p>Tel.:</p> <p>Cel.:</p> <p>E-mail: abethancourt@aeronautica.gob.pa</p>
PARAGUAY	<p>Sindulfo Ibarrola Aquino FMU SGAS Tel.:</p> <p>Cel.:</p> <p>E-mail: fm.asu@gmail.com</p> <p>La Unidad Central de Tráfico Aéreo – CFMU Lic. Esp. Enrique Espinoza Tel/Fax: +595-2121-0628 E-mail: cfmu@dinac.gov.py; cfmu.py@gmail.com</p> <p>Unidad de Flujo (SGES) – FMU SGES (Unidad Operativa) Lic. ATCO David Gavilán Tel/Fax: +595 6442-0815 E-mail: daga_978@hotmail.com</p>
PERÚ	<p>José Mondragón Hernández Inspector de Navegación Aérea Dirección General de Aeronáutica Civil Tel.: +511 615-7881 Cel.: +51 99044-0563 E-mail: jmondragon@mtc.gob.pe</p> <p>Responsable Área de los Servicios de Tránsito Aéreo: Sr. José Carlos Gómez Herrera Aeropuerto Intl. Jorge Chávez Lima-Perú Tel/Fax: +511 414-1380 E-mail: jcgomezh@corpac.gob.pe</p> <p>Responsable actual de la Unidad: Supervisor ATC Renzo Gallegos Begazo Aeropuerto Intl. Jorge Chávez Lima-Perú Tel/Fax: +511 414-1380 E-mail: rgallegos@corpac.gob.pe rgbegazo@hotmail.com</p>

Estado/ State	Responsable ATFM-Nombre, FMU/ACC, correo electrónico, teléfono / ATFM responsible-Name, MU/ACC, e-mail, telephone
SURINAME	
URUGUAY	<p>Gustavo Turcatti Jefe Departamento Operativo Tel.: +5982 604 0408 Int.5111 Cel.: E-mail: dota@dinacia.gub.uy</p> <p>Adriana San German Jefe Depto Técnico Tel.: +5982 604 0408, Int. 5109 Cel.: E-mail: dtta@dinacia.gub.uy</p>
VENEZUELA	<p>Maribel Mayora Vallenilla Responsable ATFM</p> <p>Wilfredo Gil Jefe ACC Tel.: +58212 355-2912 Cel.: E-mail: atfm@inac.gob.ve</p> <p>Maruska Borges R. Unidad FMU/ATFM/Venezuela ATC/Aeropuerto Intl.Maiquetía Experto ATFM Tel.: +58212 355-2912 Cel.: +(58414 299- 3995 E-mail: ma.borges@inac.gob.ve</p>

APPENDIX D

MODEL LETTER OF ATFM OPERATIONAL AGREEMENT

1. INTRODUCTION

In order to provide an efficient regional ATFM service, close coordination and an effective exchange of ATFM information between ATFM units are required.

2. EFFECTIVE DATE

The effective date of the Letter of Agreement will be defined.

3. OBJECTIVE

The overall objective of this Letter of Operational Agreement is to define coordination and ATFM information exchange procedures concerning air traffic in the XXXX and XXXX FIRs flying to coordinated and monitored airports.

4. SCOPE

The procedures contained in this Letter of Operational Agreement are consistent with the recommendations of the International Civil Aviation Organization (ICAO) and will be applied to all air traffic whose flight plan lists as its destination one of the following airports covered by this agreement:

- **XXXX FIR**
 - **XXXX Airport**

- **XXXX FIR**
 - **XXXX Airport**

5. DEFINITIONS

AAR:	AERODROME ACCEPTANCE RATE
ADR:	AERODROME DEPARTURE RATE
ATFM:	AIR TRAFFIC FLOW MANAGEMENT
AFTN:	AERONAUTICAL FIXED TELECOMMUNICATION NETWORK
AIM:	ATFM INFORMATION MESSAGE
ANM:	ATFM NOTIFICATION MESSAGE
FMU:	FLOW MANAGEMENT UNIT

6. AIRPORTS AND AIRSPACES

Specifies the characteristics, identification, boundaries, and declared AAR/capacity of airports and airspaces covered by the Letter of Agreement.

7. ATFM UNITS

Specifies the characteristics of ATFM units involved in the provision of this service at the airports and airspaces covered by the Letter of Agreement.

8. COORDINATION PROCEDURES

Establishes common methods concerning operations and resolution of conflicts between incompatible procedures, and the means available. Diagrams may be included to facilitate their explanation.

9. EXCHANGE OF ATFM MOVEMENT INFORMATION

The exchange of ATFM information will be based on the methods set forth in Chapter 11 of ICAO Doc 4444/ATM501 “Air Traffic Management (PANS-ATM)”.

9.1. The messages listed in the table below are to be used for the exchange of ATFM movement information:

MOVEMENT MESSAGES		
MESSAGE CATEGORY	MESSAGE TYPE	MESSAGE TYPE DESIGNATOR
MOVEMENT MESSAGES (FF)	Filed flight plan	FPL
	Delay	DLA
	Change	CHG
	Flight plan cancellation	CNL
	Departure	DEP
	Arrival	ARR
COORDINATION MESSAGES (FF)	Current flight plan	CPL
	Estimate	EST

9.2. Basic flight plan data required for flow control procedures will be provided at least 60 minutes before each flight (11.3.2/ICAO Doc 4444/ATM501).

9.3. Flight plan data filed before the flight will be updated if there are any time changes or other essential information that might be required (11.3.2.1/ICAO Doc 4444/ATM501).

9.4. Movement messages will be addressed to the air traffic flow management centres concerned (11.3.6/ICAO Doc 4444/ATM501).

9.5. Messages concerning actual or foreseen aircraft movement will be based on the latest information provided to ATS units by the pilot, the operator or its designated

representative, or obtained from an ATS surveillance system (11.4.2/ICAO Doc 4444/ATM501).

- 9.6. Unless basic flight plan data is already available by virtue of agreements concerning repetitive flight plans, an FPL message will be sent to all centres responsible for a FIR or upper FIR along the route that is not in a position to process current data. Furthermore, an FPL message will be sent to the control tower of the destination aerodrome. If necessary, an FPL message will also be sent to flow control centres responsible for ATS units along the route (11.4.2.2.2.2 b/ICAO Doc 4444/ATM501).

10. ATFM OPERATIONAL INFORMATION

Specifies the procedures and means for the exchange of operational information relevant to air operations, such as: operational constraints, projected capacity, air traffic management initiatives, condition of radio aids, meteorological information, etc.

11. ATFM MESSAGES (FF)

ATFM units will keep information on planned and current air traffic management initiatives up to date through the messages described below and will use the aeronautical fixed telecommunication network for their dissemination.

AIM. ATFM information message. An information message offered by an ATFM unit containing ATFM information, advice, and instructions to air operators based on the planned capacity of an ATFM strategic planning phase (**Annex 1**).

ANM. ATFM notification message. A notification message on the regulations planned by an ATFM unit in the ATFM pre-tactical and tactical phases, and which may be updated on a regular basis (**Annex 1**).

12. INTERNATIONAL ATFM OPERATIONAL PLANNING TELECONFERENCE (TELCON)

Describes the procedure for conducting TELCONs, the schedule and format to be used based on the agreement reached between ATFM units.

13. CONTINGENCIES

Lists the procedures to be followed in case of any failure affecting the provision of the ATFM service.

14. REVISIONS

Defines when the Letter of Agreement must be reviewed.

15. DISSEMINATION

Specifies the scope of dissemination of the Letter of Agreement and indicates whether the Letter of Agreement supersedes, supplements or somehow affects previous agreements.

16. ANNEXES

The corresponding annexes to the Letter of Agreement are attached.

ANNEX 1

**AIM MESSAGE
CODE, DESCRIPTION, ATFM INITIATIVE**

FROM: 06/05/2009 00:00 UNTIL: // : RELEASED: 06 - 11:58

DESCRIPTION: REPAVING OF RUNWAY 13L

MESSAGE DETAIL: -----

SUBJECT: WORKS ON RUNWAY 13L

REF: NOTAMS C1067/97 AND A1088/97

-

REPAVING OF RUNWAY 13L STARTING 24 JUNE 2009 ENDING 10 OCTOBER 2009.

-

SCHEDULE: 0600-2000 UTC

-

SCOPE: ARRIVALS AND DEPARTURES ELDORADO AIRPORT.

-

PROJECTED CAPACITY: AAR 25 ADR 30

CODE DESCRIPTION

FROM/UNTIL: Date and time of start/end of message.

RELEASED: Date and time of issuance of the AIM message.

DESCRIPTION: Summarised description of the AIM message.

DETAIL: The message in detail.

**ANM MESSAGE
CODE, DESCRIPTION, ATFM INITIATIVE**

ANM VALID: 04/06/2007 NUM: 001 RELEASE: 041026		
AREA CONCERNED _____	FL _____	FROM/TO _____
SKBO NEW		
DEST SKBO	ALL	0600 0800
REGULATION	20 OPS/H	
REASON: G		
RMK: NOTAM C1345/07		

CODE DESCRIPTION:

ANM: Type of message (ATFM notification message).

VALID: Effective date of the message.

NUM: Day sequence number.

RELEASE: Date and time of issuance.

AFFECTED AIRPORT/SECTOR: (SKBO) and status of regulation (NEW, CANCEL, CHANGE).

AREA CONCERNED: Traffic to which the regulation applies (*e.g.*: DEST SKBO).

FL: Flight levels affected (*e.g.*: ALL).

FROM/TO: Period of validity of the constraint.

REGULATION: Operations/Time.

REASON: TMI REASON. **TMI code (Annex 2)**

RMK: Remarks.

**ANNEX 2
TMI CODES**

REASON FOR REGULATION	CODE	LOCATION OF REGULATION	EXAMPLE
ATC capacity	C	D	<i>Demand exceeds capacity</i>
		E	
		A	
Action by ATC	I	D	<i>Strike or walkout of controllers</i>
		E	
		A	

REASON FOR REGULATION	CODE	LOCATION OF REGULATION	EXAMPLE
ATC routings	I	E	<i>Applying new procedures</i>
ATC equipment	T	D	<i>Radar failure / Frequency outage</i>
		E	
		A	
Accident Incident	A	D	<i>Runway 13L closed due to accident</i>
		A	
Airport capacity	G	D	<i>Lack of aircraft stands, closed taxiways, demand exceeds airport declared capacity</i>
		A	
Navigation aids	E	D	<i>Runway lighting system failure, failure of LLZ or GP</i>
		A	
Airport services	N	D	<i>Strike of the fire-fighting department</i>
		A	
Military activities	M	D	<i>OP operations</i>
		E	
		A	
Special events	P	D	<i>Visits by dignitaries</i>
		A	
Meteorology	W	D	<i>Storms, low visibility, wind</i>
		E	
		A	
Environmental issues	V	D	<i>Noise, birds</i>
		A	
Other	O	D	<i>Hijacking, bombs</i>
		E	
		A	

- Scope **D** Take-off / **E** En route / **A** Landing

ANNEX 3

**INTERNATIONAL OPERATIONS
PLANNING TELCON FORMAT**

PRESENTATION:

Good morning everybody, this is (NAME) _____ from COLOMBIA FLOW MANAGEMENT UNIT, we are going to begin the NATIONAL ATFM INFORMATION (DATE) _____ at (TIME) _____ UTC, this will be valid until today at (TIME) _____ UTC.

1. WEATHER INFORMATION

1.1. COMMON WEATHER PRODUCTS FOR COLOMBIA

- a. The ICAO Area “A” Prog Chart, valid _____ UTC for (Date) _____
- b. The ICAO Area “A” IR Satellite photo, _____ UTC for (Date) _____
- c. **REMARKS, SIGNIFICANT WEATHER AND ATMOSPHERIC CONDITIONS** (*convective activity, Thunderstorm activity, Turbulence, Volcanic ash clouds*). _____

1.2. WEATHER INFORMATION FOR ELDORADO INTERNATIONAL AIRPORT

- a. **METAR SKBO** (Rwy, ceiling and visibility) _____
- b. **TAF SKBO** (*Probably light rain in the afternoon, Thunderstorm activity over the airport, Turbulence, Volcanic ash clouds*) _____
- c. **WEATHER CONDITIONS PREDICTED** (VMC/IMC) _____

1.3. WEATHER INFORMATION FOR INTERNATIONAL AIRPORTS – TAF (*Probably light rain in the afternoon, Thunderstorm activity over the airport, Turbulence, Volcanic ash clouds*).

- a. **TAF**(Airport) _____
- b. **TAF**(Airport) _____
- c. **TAF**(Airport) _____

2. TERMINAL DISCUSSION

2.1. ELDORADO INTERNATIONAL AIRPORT

- AAR_____
- PROJECTED AAR_____ BTN_____ UTC DUE
TO_____ (NOTAM).
EXAMPLE: *Aerodrome constraints, such as construction projects or NAVAID outages.*_____
- ANTICIPATED TRAFFIC MANAGEMENT INITIATIVES
EXAMPLE: *Expanded miles-in-trail, potential airborne holding, potential ground stops*

2.2. INTERNATIONAL AIRPORTS OR TMA

3. ENROUTE DISCUSSION

(Enroute constraints, such as frequency outages or NAVAID outages, route discussion and issues)._____

routes and traffic
affected_____

ANTICIPATED TRAFFIC MANAGEMENT INITIATIVES (Expanded miles-in-trail,
Potential airborne
holding)_____

4. COMMENTS AND QUESTIONS

TFM (NAME AND SIGNATURE)

17. SIGNATURES

Lists the position and signature of those responsible for approving the Letter of Agreement, as well as the date of approval.

APPENDIX E

STATUS OF IMPLEMENTATION IN PARAGUAY

A- AIRPORT	
Description of tasks	Status of implementation
<p>1. Analysis of airport demand and capacity (runway capacity)</p> <ul style="list-style-type: none"> • Identify the personnel available in each State for calculating runway capacity. • Identify airports where runway capacity calculation is already available. • Identify, prioritise, and list airports that require runway capacity calculation. • Calculate runway capacity. • Identify which airports exceed their runway capacity. • Identify which airports have periods in which demand exceeds capacity, including simulations by the States, as necessary. • Determine the operational factors affecting airport demand and capacity in order to optimise the use of existing capacity, including simulations, as necessary. • Indicate airport capacity in terms of aircraft operations at the main airports. 	<p>Defined</p> <p>Defined</p> <p>Defined</p> <p>To be updated</p> <p>To be determined</p> <p>To be determined</p> <p>To be determined</p> <p>Report to SAM/IG/13</p>
<p>2. Coordination with the ATM community</p> <ul style="list-style-type: none"> • Promote seminars for the ATFM community, taking into account the CDM concept for ATFM implementation, and start coordination as relevant. • Consider the implementation of a CDM process at the main airports. • The States will indicate which airports have this process in place. 	<p>In progress</p> <p>In progress</p> <p>In progress</p>
<p>3. Infrastructure and database</p> <ul style="list-style-type: none"> • Establish a database format to be used for automation. 	<p>To be determined</p>
<p>4. Policy, standards and procedures</p> <ul style="list-style-type: none"> • Request States to provide information on AIPs/AICs published on ATFM. • Standardise this information. • Update the information. 	<p>In progress</p>
<p>5. Training</p> <ul style="list-style-type: none"> • Draft ATFM training plans. • Train FMP/FMU/ATC personnel for the implementation of ATFM measures at airports. • Supervise training of the ATM community. 	<p>In progress</p>

<p>6. Implementation go/no-go decision</p> <ul style="list-style-type: none"> • Analyse factors affecting the implementation decision. • Declare pre-operational implementation within the defined area. • Declare definitive operational implementation within the defined area. 	D.A.C.
<p>7. Monitor system performance</p> <ul style="list-style-type: none"> • Develop performance indicators in accordance with the CDM manual. • Implement ATFM post-implementation monitoring programme at airports. • Develop an indicator monitoring programme. 	<p>To be determined 2013 To be determined 2013 To be determined 2013</p>

B- AIRSPACE (ATC SECTOR)	
Description of tasks	Status of implementation
<p>1. Analysis of airspace demand and capacity</p> <ul style="list-style-type: none"> • Conduct ATC sector calculations. • Identify the personnel available in each State for calculating airspace capacity. • Identify sectors where capacity calculation is already available. • Identify, prioritise, and list sectors that require capacity calculation. • Identify which sectors exceed their capacity. • Calculate airspace capacity (ATC sector) of State airspace regions. • Identify which airspace sectors have periods in which demand exceeds capacity, including simulations by States, as necessary. • Determine the operational factors affecting airspace demand and capacity in order to optimise the use of existing capacity, including simulations, as necessary. • Submit the conclusions regarding existing airspace capacity. 	<p>In progress Defined Defined To be determined To be determined In progress To be determined To be determined For SAM/IG/13</p>
<p>2. Coordination with the ATM community</p> <ul style="list-style-type: none"> • Promote seminars for the ATFM community, taking into account the airspace capacity concept for ATFM implementation, and start coordination as relevant. 	In progress
<p>3. Infrastructure and database</p> <ul style="list-style-type: none"> • The ATFM/IG will submit the basic requirements for a regional automated system. • Coordinate implementation activities with the Automation Group. 	<p>To be determined To be determined</p>

B- AIRSPACE (ATC SECTOR)	
Description of tasks	Status of implementation
<p>4. Policy, standards, and procedures</p> <ul style="list-style-type: none"> • Develop ATFM policies, taking into account the objectives and principles established in the CAR/SAM ATFM CONOPS. • Develop a strategy and frame of reference for the implementation of ATFM centralised units. • Develop a form/content for operational agreements between centralised ATFM units for inter-regional demand/capacity balancing. • Define common situational awareness elements: <ul style="list-style-type: none"> * common display of traffic; * common display of weather conditions (Internet); * communications (teleconferences, web). • Review the regional ATFM implementation roadmap to be used by States as FMU/FMP implementation guide. • Develop a regional strategy for the implementation of the flexible use of airspace (FUA). <ul style="list-style-type: none"> * assess management processes concerning the use of airspace; * improve current airspace management at national level so as to make dynamic adjustments in traffic flows in the tactical stage; * make improvements to ground ATS systems and related procedures in order to extend FUA through dynamic airspace management processes; *implement dynamic ATC sectorisation to optimise demand/capacity balancing and be able to respond to changing traffic flows in real time, and to accommodate user-preferred paths in the short term. 	<p>Defined</p> <p>Defined</p> <p>To be determined</p> <p>To be determined</p> <p>Defined</p> <p>To be determined</p>
<p>5. Training</p> <ul style="list-style-type: none"> • Train personnel in sector capacity calculation and airspace ATFM-related issues. • Draft ATFM plans and training material. • Provide training to the personnel involved. 	<p>In progress</p> <p>In progress</p> <p>In progress</p>
<p>6. Implementation go/no-go decision</p> <ul style="list-style-type: none"> • Analyse factors affecting the implementation decision. • Declare pre-operational implementation within the defined area. • Declare definitive operational implementation within the defined area. 	<p>D.A.C.</p>
<p>7. Monitor system performance</p> <ul style="list-style-type: none"> • Develop performance indicators. • Develop an indicator monitoring programme. 	<p>To be determined</p> <p>To be determined</p>

APPENDIX F

1. AUTOMATED AIR TRAFFIC FLOW MANAGEMENT SYSTEM

- 1.1. This system shall:
 - 1.1.1. Permit a continuous analysis and monitoring of traffic flows, on-going coordination between ATFM/ATC units, and dynamic application of ATFM initiatives.
 - 1.1.2. Execute ATFM efficiently through basic functions running on specific applications to:
 - 1.1.3. Display the status of excess demand alerts, as well as meteorological information, sector map layers, intersections, radio aids, and airports.
 - 1.1.4. Generate from the database, reports on:
 - a) Fights arriving/departing at/from airports and crossing sectors;
 - b) Demand over intersections;
 - c) Flight plans;
 - d) Delays;
 - e) Schedule verification.
 - 1.1.5. Monitor ATFM initiatives on a calculated take-off time (CTOT) database.
 - 1.1.6. Manage the three ATFM planning phases (strategic, pre-tactical, tactical) on a schedule database.
 - 1.1.7. Monitor real-time demand related to different airports, sectors, and intersections on an air traffic database.
 - 1.1.8. Generate air traffic reports that support excess demand monitoring and alerting features.
 - 1.1.9. Predict delays on a database, based on historical data.
 - 1.1.10. Permit the display of real-time status of air traffic demand and capacity at airports to support collaborative decision-making for the implementation of ATFM initiatives.
 - 1.1.11. Permit the simulation and assessment of the effects of the implementation of the various ATFM initiatives.
 - 1.1.12. Permit the generation and delivery of ATFM notifications or messages in general to different addresses of the (domestic/international) AMHS/AFTN network, data link networks (ARINC or SITA), other ATFM units, or workstations of the ATFM system.

- 1.1.13. Permit the generation of automatic delay forecast messages when applying ATFM measures, based on delay alerts and delay forecast reports.
- 1.1.14. Provide information on airports, radio aids, intersections, preferential routes, main traffic flows, and monitored routes.
- 1.1.15. Permit the mapping and printing of the results of the demand/capacity analysis in each ATFM planning phase, using automatic and manual functions.
- 1.1.16. Permit the tactical determination of sustainable ATC sector and airport capacity.
- 1.1.17. Permit the assignment of operational slots in a CDM environment during ATFM planning phases, through the exchange of information with aircraft and airport operators and the use of web applications, based on capacity.
- 1.1.18. Manage take-off and landing sequencing using slot assignment at airports that so require.
- 1.1.19. Monitor current and foreseen sector and airport demand on an on-going basis, comparing it with sustainable capacity in order to trigger possible alerts in the ATC system.
- 1.1.20. Permit real-time display of air traffic status.
- 1.1.21. Permit the display of airspace and airport structure (runway, taxiway, control sector configuration).
- 1.1.22. Permit capacity calculation based on operational restrictions or configurations of airports and ATC sectors.
- 1.1.23. Permit the monitoring of the operational status of CNS infrastructure and the issuance of graphical and printed reports.
- 1.1.24. Permit the identification of periods of excess demand in control sectors and airports.
- 1.1.25. Permit the (graphical and printed) modelling of ATFM initiatives to regulate demand.
- 1.1.26. Permit constant updating of known and foreseen demand, its comparison with evolving operating conditions (meteorological, CNS infrastructure, AGA, airport, ATC limitations), and the adjustment of flow management initiatives.
- 1.1.27. Permit the generation of alerts when demand/capacity imbalances occur, as well as the modelling and display of the impact of possible flow management initiatives, with a view to coordinating these initiatives with the CDM community and identifying the best option to resolve such imbalances.
- 1.1.28. Permit the implementation of automatic and/or manual ATFM initiatives for assigning the corresponding calculated take-off times.

- 1.1.29. Permit the real-time generation of statistics to provide ATFM operational information concerning the efficiency and evolution of ATFM initiatives.
- 1.1.30. Permit the generation of graphical and printed ATFM post-operational statistics and information for different analytical periods.
- 1.1.31. Permit the generation of graphical and printed reports on minutes of delay caused to all flights due to demand/capacity imbalances, and on the ATFM initiatives applied.
- 1.1.32. Permit the supply of slot assignment and operational information to aircraft operators.
- 1.1.33. Allow aircraft operators to exchange slots in real time for their flights (pre-tactical and tactical phase) to optimise the use of available capacity.
- 1.1.34. Permit aircraft operators to replace slots based on the evolution of plans and operating interests.
- 1.1.35. Allow the CDM community to monitor the impact of adverse meteorological conditions on capacity and operational efficiency.
- 1.1.36. Permit flight data processing in order to deliver databases on coordinated flights to control centres.
- 1.1.37. Permit the generation of data on capacity, demand, delays and CNS infrastructure for use in the various ATFM operational teleconferences (at national, South American, and international level).
- 1.1.38. Permit database storage and modification.
- 1.1.39. Permit the integration of weather forecasts, meteorological radar information, and meteorological satellite images.
- 1.1.40. Embrace and support the following CDM objectives:
 - a) Provide information updated in real time to all ATFM community stakeholders, thus ensuring the most accurate prediction of events and optimised use of capacity, with the support of a collaborative decision-making process;
 - b) Balance air traffic demand with service capacity, while meeting the agreed safety and efficiency levels;
 - c) Permit the ATFM community that uses the system to optimise collaborative decision-making, taking into account its preferences, limitations and the current and foreseen operational situation, and using functionalities such as slot substitution, flight cancellation, flight holding, flight prioritisation, etc.;
 - d) Permit all the members of the ATFM community, especially airspace users, to participate in the adoption of decisions affecting them;

- e) Reach an acceptable solution based on the needs of stakeholders through CDM;
 - f) Foresee and alert on conflicting situations derived from excess demand;
 - g) Identify safe and efficient solutions through CDM;
 - h) Exchange ATFM and CDM information with other stakeholders in real time and in advance.
- 1.1.41. Make sure that all system stakeholders operate equitably for the sake of safety and efficiency.
- 1.1.42. Provide the necessary ATFM functions during the strategic (slot coordination); pre-tactical (slot coordination, ATFM initiatives, and ATFM slot assignment), and tactical (ATFM initiatives and ATFM slots) planning phases, with a view to maintaining a balance between planned air traffic capacity and demand.

Agenda Item 5: Assessment of operational requirements in order to determine the implementation of communications, navigation, and surveillance (CNS) capabilities improvement for en-route and terminal area operations

5.1 Under this Agenda item, the following papers were analysed upon:

- WP/09: *Follow-up to the implementation of the new South American digital network -- REDDIG II* (Secretariat);
- WP/11: *Implementation of national IPS networks* (Secretariat);
- WP/10: *Follow-up to AMHS interconnection* (Secretariat);
- WP/27: *Guideline for the implementation of air-ground data link applications in the SAM Region* (Secretariat);
- WP/13: *Follow-up to the implementation of the via web RAIM availability prediction service* (Secretariat).

5.2 The above indicated working papers dealt with the following topics:

- Activities within the Project ATN Architecture in the SAM Region, D1;
- Activities carried out by the Project ATN Ground-ground and Air-ground Applications in the SAM Region, D2; and
- Hiring of a via Web RAIM availability prediction service.

Activities within the Project ATN Architecture in the SAM Region – D1

Progress in REDDIG II implementation

5.3 The Meeting was informed that, as part of the already started Phase 1, the bid winner presented in mid-August 2013 the REDDIG II design documents, installation procedures, training manuals, factory, site, and network acceptance documents, network management system (NMS). This documentation was submitted to all REDDIG II focal points, for their initial reviews.

5.4 The final review of the documentation was carried out during the Meeting on the Technical-Operational Implementation of the New REDDIG II Digital Network (Lima, Peru, 9-13 September 2013). The comments to the SDD were sent to the contractor via the ICAO Technical Cooperation Bureau (TCB), who will draft the definite proposal by the end of this month. **Appendix A** to this Agenda item presents the updated tentative chronogram for REDDIG II implementation.

5.5 Phase 2 includes REDDIG II installation and will start in November 2013, since all REDDIG member States have deposited their corresponding contributions.

5.6 In addition, with regard to the effective implementation of the new communications infrastructure, the role of the focal points nominated by States will be decisive for the success of all actions was reiterated upon. The main functions will be to participate in the installation of the corresponding REDDIG II node, the provisional and final node acceptance, the obtainment of the frequency license, and the customs clearance of the equipment.

5.7 A recall was made that all information related with project RLA/03/901 - *REDDIG Management System and Satellite Segment Administration*, is available at: <http://www1.lima.icao.int/reddig/>.

5.8 The Meeting noted that, as part of the preparatory activities for REDDIG II implementation (Phase 2), a technical-operational meeting is planned to be held in Lima, Peru (aimed for all REDDIG focal points) in March 2014, to coordinate the REDDIG II nodes implementation activities, as well as a levelling course on REDDIG II offered by the Colombian civil aviation administration, to be conducted in April 2014 in Bogotá. These courses will be covered by project RLA/03/901 - *REDDIG Management System and Satellite Segment Administration*.

National ATN networks

5.9 The implementation of domestic IP ATN networks to support aeronautical applications in support of the air traffic control is an important regional goal, considered upon in the *Air Navigation System Performance-Based Air Navigation System Implementation Plan for the SAM Region (PBIP)*. Therefore and since its inception, the SAM/IG considered the implementation of national IPS networks as an important improvement to be implemented (REDDIG II is proof of that).

5.10 With AMHS implementation, most of the States of the Region have improved their links through the use of IP protocol, but *very few* have implemented national IP networks on which to mount the several aeronautical services. Practically only one State of the Region has implemented it in this manner (all voice and data ATS, AIS and MET services have been mounted over the network, with the exception of the aeronautical mobile service).

5.11 The Meeting took note that other States of the Region have AMHS, IP radar data and voice installed, but mounted over different networks, thus difficulting their integration and management. Some States of the Region have plans for owning IP networks in the short term, while others foresee improving the networks leased to communications services providers.

5.12 **Appendix B** indicates the dates scheduled by the administrations to run the various services through the IP network constituting their national Aeronautical Telecommunications Network (ATN).

5.13 On the other hand, the Meeting approved the *Guide on security for the implementation of IP networks* and the *Guide on the routing policy for the SAM Region*, with the comments received by the States of the Region. The guides were presented at SMA/IG/11 meeting and submitted to all SAM States through letter LT 12/3.54 SA302 of 10 June 2013.

Situation of Project D1

5.14 The Meeting agreed that the only pending activity was the follow-up to REDDIG II implementation. In addition, taking into account that the previous Project D1 coordinator (Mr. Athayde Frauche), ceased the function as he retired from the Brazilian administration, the Meeting agreed that the representative of Brazil, Mr. Francisco Almeida da Silva, act in his replacement.

Follow-up to Project ATN Ground-ground and Air-ground Applications in the SAM Region - D2

Follow-up to AMHS operational interconnection

5.15 With regard to the difficulties encountered in the international operational interconnections between different provider systems, note was taken of the presence of one of these system providers (Skysoft, who took charge of the installations carried out by Radiocom Inc.) with the aim of providing his opinion with respect to the current problems faced. Therefore, at the request of the Secretariat, a meeting was held at the site with CORPAC AMHS personnel to discuss the configuration aspects which are the main problem with the interconnection.

5.16 Once the visit had concluded, the Meeting held an extensive and exhaustive technical discussion on the interconnectivity problem at hand (including the review to Conclusion SAM/IG/11-4), determining that, in spite of evident efforts of all States involved, the causes hindering the expected result have yet to be identified, agreeing in superseding the mentioned conclusion by the following:

Conclusion SAM/IG/12-3 International AMHS interconnection

That, with regard to international operational AMHS interconnections and with the aim of solving apparent incompatibility problems between the systems installed in Argentina, Brazil and Venezuela with the AMHS in Peru, these States carry out corresponding efforts so:

- a) Their providers determine and inform the precise causes preventing the interconnections, and appropriately indicate the procedures to solve them; and
- b) They inform the results of the evaluation at SAM/IG/13 meeting.

5.17 On the other hand, the Meeting took note of the progress made in AMHS interconnection, showing in **Appendix C** the interconnection dates expected for the next three (3) years.

5.18 In addition to the indications in the mentioned Appendix, the representatives of Argentina and Brazil informed that the interconnection between both States would start in the coming months (2013), which would be coordinated for its carrying out in two phases.

5.19 In addition, the Meeting took note of the holding of a Course on ATS Message Handling System (AMHS) in Lima from 24 to 28 June 2013, to contribute in the future international interconnections.

Operational integration of international AIDC connections in the SAM Region

5.20 With regard to this activity, the Meeting was informed that an AIDC course for air traffic controllers would be carried out in Montevideo, Uruguay, from 9 to 13 December 2013, with the support of the Argentinian aeronautical administration and project RLA/06/901. It is expected that by the end of 2013 at least three AIDC interconnections will be implemented through AMHS (ACC Guayaquil - ACC Lima, ACC Ezeiza - ACC Asunción and ACC Ezeiza - ACC Montevideo. Additional information on AIDC implementation is found under Agenda Item 6.

Guideline for the implementation of air-ground data link applications in the SAM Region

5.21 The Meeting noted that, in accordance with Project D2 activities and thanks to the support of project RLA/06/901 and the Brazilian aeronautical administration, an expert from said State drafted a *Guideline for the implementation of air-ground data link applications in the SAM Region*, which was analysed upon by the Meeting. From its reading, it was concluded that same was appropriate, deeming convenient its submission to the States of the Region for their review. The preliminary Guide is included in **Appendix D** to this Agenda item.

5.22 Note was also taken on the holding of an air-ground data link conference organized by SITA, to be carried out in Miami, Florida, from 28 to 30 October 2013.

Implementation of a tool for the prediction of RAIM availability in the SAM Region

5.23 The Meeting recalled that RLA/06/901 project document (Version J) had been amended with the inclusion of the RAIM availability prediction service and submitted to all RLA/06/901 member States through letter LN 3/24.2-SA5666 of 27 September 2013 for its signature and remittance to the ICAO SAM Regional Office before 16 October 2013.

5.24 The Meeting was informed that the public bidding process for the implementation of the RAIM prediction services was started by the ICAO TCB on 23 August 2013, on the basis of the final technical specifications shown in **Appendix E**. The offers evaluation was conducted at the ICAO TCB in Montreal, from 1 to 3 October 2013, with the participation of the ICAO SAM CNS Regional Officer, representatives from Brazil and ICAO TCB Officers. All project RLA/06/901 member States were invited to participate in the evaluation (letter LN 3/24.2-SA5590 of 28 August 2013).

5.25 The evaluation of the offers was carried out through an assessment criteria previously prepared and of knowledge to the bidders participating in the process, which is presented as **Appendix F**. Three companies presented offers at the bid, but only two were evaluated, as the remainder was discarded by TCB for not complying with the bidding standards.

5.26 As a result of the technical and commercial evaluation, a company was recommended as winner. The Meeting proceeded to endorse the results of the bidding evaluation for the implementation of the web RAIM availability prediction service. In this respect, the Meeting formulated the following conclusion:

Conclusion SAM/IG/12-4

Approval of Web RAIM availability prediction service bidding process

That, the Meeting, as result of the technical and commercial evaluations made to the proposals presented at the RAIM availability prediction service bidding process, proceeded to analyse same and endorse the results obtained.

Appendix A to Report on Agenda Item 5 / Apéndice A al Informe sobre la Cuestión 5 del Orden del Día

APPENDIX A / APENDICE A

TENTATIVE TIME SCHEDULE / PHASES (31 August 2012) / PROGRAMA TENTATIVO - FASES (31 agosto 2012)

ID	Nom de la tâche	Duration	Qtr 2, 2013			Qtr 3, 2013			Qtr 4, 2013			Qtr 1, 2014			Qtr 2, 2014			Qtr 3, 2014			Qtr 4, 2014			Qtr 1, 2015			Qtr 2, 2015			Qtr 3, 2015			Qtr 4, 2015			Qtr 1, 2016		
			Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
1	Tentative REDDIG II implementation work programme / Programa tentativo de trabajo implantacion REDDIG II	371.71 days	[Timeline bar from Mar 2013 to Mar 2016]																																			
2	Phase 1 - Project / Fase 1 - Proyecto	156 days	[Timeline bar from Mar 2013 to Jun 2014]																																			
3	Documentation drafting and approval process / Proceso de elaboración y aprobación documentación	156 days	[Timeline bar from Mar 2013 to Jun 2014]																																			
4	REDDIG II preliminary design installation / Preparación diseño preliminar instalación REDDIG II (SDD)	40 days	[Timeline bar from Mar 2013 to Apr 2013]																																			
5	Preparation of installation and training procedures documentation and NMS documentation preparation / Preparación documentos de procedimiento de instalación y capacitación y preparación documentación del sistema NMS	15 days	[Timeline bar from Mar 2013 to Apr 2013]																																			
6	FAT protocol preparation / Preparación protocolo FAT	10 days	[Timeline bar from Mar 2013 to Apr 2013]																																			
7	SAT protocol preparation / Preparación protocolo SAT	10 days	[Timeline bar from Mar 2013 to Apr 2013]																																			
8	Documentation submittance (SDD, FAT/SAT protocol, on-site installation procedure, training manuals) to ICAO / Envío documentación (SDD, protocolo FAT/SAT, procedimiento instalación sitio, manuales de capacitación) a OACI	0 days	[Milestone diamond at 15/08]																																			
9	Documentation review / Revision de la documentación	12 days	[Timeline bar from Aug 2013 to Sep 2013]																																			
10	Technical-operational meeting / Reunión técnico-operacional	5 days	[Timeline bar from Aug 2013 to Sep 2013]																																			
11	Final design/Diseño finalizado	23 days	[Timeline bar from Aug 2013 to Sep 2013]																																			
12	Documentation reviewed and approved / Documentos revisados y aprobados	0 days	[Milestone diamond at 16/10]																																			
13	Schedule DRM / Cronograma DRM	30 days	[Timeline bar from Oct 2013 to Nov 2013]																																			
14	Phase 2 - REDDIG II implementation / Fase 2 - Implantación de la REDDIG II	246 days	[Timeline bar from Oct 2013 to Mar 2016]																																			
15	Purchasing and integration of VSAT equipment / Adquisición e integración equipos VSAT	35 days	[Timeline bar from Oct 2013 to Nov 2013]																																			
16	Purchasing of equipment and remittance to company HQ for integration / Adquisición de equipos y envío a la sede de la empresa ganadora para su integración	7 wks	[Timeline bar from Oct 2013 to Nov 2013]																																			
17	Preparation of ground backbone network / Preparación red medular terrestre	30 days	[Timeline bar from Oct 2013 to Nov 2013]																																			
18	Hiring of service for all nodes / Contratación de servicio para todos los nodos	1 wk	[Timeline bar from Oct 2013 to Nov 2013]																																			
19	Equipment purchasing / Adquisición equipos	6 wks	[Timeline bar from Oct 2013 to Nov 2013]																																			
20	Integration at factory, training and FAT / Integración en fábrica, entrenamiento y FAT	45 days	[Timeline bar from Oct 2013 to Nov 2013]																																			
21	Equipment assembling at factory / Ensamblar equipos en fábrica	6 wks	[Timeline bar from Oct 2013 to Nov 2013]																																			
22	Network configuration and pre-test / Configuración y pre-test de la red	8 wks	[Timeline bar from Oct 2013 to Nov 2013]																																			
23	Documentation submittance for on-factory-training / Envío documentación para entrenamiento en fábrica	0 wks	[Milestone diamond at 03/01]																																			
24	On-factory-training / Entrenamiento en fábrica	3 wks	[Timeline bar from Dec 2013 to Jan 2014]																																			
25	FAT	5 days	[Timeline bar from Dec 2013 to Jan 2014]																																			
26	FAT signature / Firma FAT	0 days	[Milestone diamond at 28/02]																																			
27	REDDIG II Technical Operational Meeting/Reunión Técnica Operacional REDDIG II	5 days	[Timeline bar from Feb 2014 to Mar 2014]																																			
28	RTO Meeting/Reunión RTO	5 days	[Timeline bar from Feb 2014 to Mar 2014]																																			
29	Preparatory REDDIG II Course/ Curso preparatorio REDDIG II	5 days	[Timeline bar from Feb 2014 to Mar 2014]																																			
30	REDDIG II preliminary course in Bogotá/ Curso preparatorio preliminar de la REDDIG II en Colombia	5 days	[Timeline bar from Feb 2014 to Mar 2014]																																			
31	Remittance of equipment to sites (customs clearance 1 month approx) / Envío de los equipos a los sitios (liberación equipos aduana 1 mes tiempo estimado)	80 days	[Timeline bar from Feb 2014 to Apr 2014]																																			
32	Preparation of equipment remittance / Preparación para envío de equipos	2 wks	[Timeline bar from Feb 2014 to Mar 2014]																																			
33	Ezeiza	8 wks	[Timeline bar from Feb 2014 to Apr 2014]																																			
34	La Paz	10 wks	[Timeline bar from Feb 2014 to Apr 2014]																																			
35	Rio de Janeiro	8 wks	[Timeline bar from Feb 2014 to Apr 2014]																																			
36	Santiago	10 wks	[Timeline bar from Feb 2014 to Apr 2014]																																			
37	Bogota	9 wks	[Timeline bar from Feb 2014 to Apr 2014]																																			

APPENDIX B / APENDICE B**IMPLEMENTATION OF NATIONAL IP NETWORKS /
IMPLANTACION DE REDES IP NACIONALES**

STATE/ESTADO	IP APPLICATIONS IMPLEMENTED/ APLICACIONES IP IMPLANTADAS	DATE IMPLEMENTATION NATIONAL IP NETWORK FOR ALL IP APPLICATIONS/ FECHA IMPLANTACION RED IP NACIONAL PARA TODAS LAS APLICACIONES EN IP
Argentina	AMHS, DATA RADAR, IP VOICE/VOZ IP	2005
Bolivia	AMHS	2016
Brazil/Brasil	AMHS, DATA RADAR, IP VOICE/VOZ IP	2015
Chile	AMHS	2015
Colombia	AMHS, RADAR	2016
Ecuador	AMHS, RADAR	2014
French Guiana (France) / Guyana Francesa (Francia)	No	2018
Guyana	AMHS	2018
Panamá	AMHS, RADAR	2016
Paraguay	AMHS	2014
Perú	AMHS, RADAR	2016
Surinam	AMHS	2018
Uruguay	IP VOICE / VOZ IP	2013
Venezuela	AMHS	2015

APPENDIX C

ACTION PLAN FOR THE INTERCONNECTION OF AMHS SYSTEMS IN THE SAM REGION

ITEM	ACTIVITY	RESPONSIBLE	EXPECTED RESULT	STATUS	FINALIZATION DATE
1	<p>MoU for the interconnection of AMHS currently implemented in the SAM Region:</p> <p>a) Argentina-Brazil b) Argentina-Chile c) Argentina-Peru d) Argentina-Paraguay e) Brazil-Colombia f) Brazil-Paraguay g) Brazil-Peru h) Chile-Peru i) Colombia-Peru j) Colombia-Panama k) Colombia-Venezuela l) Peru-Venezuela m) Brazil-Suriname n) Guyana-Venezuela o) Suriname-Venezuela p) Brazil-Guyana q) Guyana-Suriname r) Brazil-Venezuela s) Bolivia-Peru t) Bolivia-Brazil u) Bolivia-Argentina v) Ecuador-Peru w) Ecuador-Colombia x) Ecuador-Venezuela y) Uruguay-Argentina z) Uruguay-Brazil</p> <p>The AMHS interconnection MoU in French Guiana (France) and Uruguay should be drafted once AMHS installation is completed at national level.</p>	SAM States involved	MoU for interconnection of AMHS systems between SAM States having AMHS implemented	a), b) c), d), e), f), g), i), l), q) & v) MoU completed	<p>Date estimates for pending MoU</p> <p>h) May 2014 j) May.2014 k) May.2014 m) Oct 2015 n) Oct 2014 o) Oct 2015 p) Oct 2014 r) May 2014 s) Oct 2015 t) Oct 2015 u) Oct 2015 w) May 2014 x) Oct 2014 y) May 2015 z) May 2015</p>

ITEM	ACTIVITY	RESPONSIBLE	EXPECTED RESULT	STATUS	FINALIZATION DATE
2	<p>Phase I Interconnection trials between MTAs of:</p> <p>a) Argentina-Brazil b) Argentina-Paraguay c) Brazil-Paraguay d) Colombia-Peru e) Argentina-Chile f) Argentina-Peru g) Brazil-Peru h) Guyana-Suriname i) Ecuador-Peru j) Brazil-Colombia k) Perú-Venezuela</p> <p>Types of tests to carry out: Network transportation; Network connectivity; Message exchange; Preparatory phase.</p> <p>Note: Inclusion has been made of only the AMHS interconnected between States having implemented and signed the MoU.</p>	Argentina, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Venezuela and REDDIG Administration	Interconnection trials between Argentina, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname and Venezuela MTAs	<p>a), f), g) message exchange trials were held between CIPE (Argentina)-Brasilia (Brazil) MTAs; the Manaus (Brazil)-Lima (Peru) MTAs, and the CIPE (Argentina)-Lima (Peru) MTAs.</p> <p>c) MoU was updated, as entrance node to Brazil will be Curitiba, and the network connectivity, and transport and exchange of messages tests will be carried out.</p> <p>b), d), h) and i) Operational interconnection trials completed</p> <p>c), e), j) No tests carried out</p> <p>k) network connectivity trials held</p>	<p>a) Jun 2012 Completed b) Mar 2012 Completed c) Mar 2014 d) Oct 2010 Completed e) Jun 2014 f) Mar 2014 g) May 2014 h) Jun 2011 Completed i) Jul 2012 Completed j) Jul 2014 k) Jul 2014</p>
3	<p>Operational interconnection implementation at the following MTA:</p> <p>a) Argentina-Brasil b) Argentina-Paraguay c) Brasil-Paraguay d) Colombia-Perú e) Argentina-Chile f) Argentina-Perú g) Brasil-Perú h) Guyana- Surinam i) Ecuador- Perú j) Brasil- Colombia k) Perú-Venezuela</p> <p>Note: Inclusion has been made of only the AMHS interconnected between States having implemented and signed the MoU.</p>	Argentina, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, and Venezuela	Operational implementation of AMHS systems	AMHS interconnection completed between following MTA, using P1 protocol and operational in b), d) h), i)	<p>a) Dec 2013 b) Mar 2012 operational c) Jul 2014 d) Nov 2010 operational e) Dec 2014 f) Jul 2014 g) Jul 2014 h) Jul 2011 Operational i) Jul 2012 Operational j) Dec 2014 k) Dec 2014</p>

APPENDIX D / APENDICE D



**GUIA DE ORIENTACIÓN PARA LA IMPLANTACIÓN DE APLICACIONES DE ENLACES
DE DATOS AIRE-TIERRA EN LA REGION SAM**

Octubre 2013

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REFERENCIAS

- AEEC 618 - *Air-Ground Character-Oriented Protocol*
- AEEC 620 - *Datalink Ground System Standard and Interface Specification*
- AEEC 622 - *ATS Datalink Applications over ACARS Air-Ground Network*
- AEEC 623 – *Character-Oriented Air Traffic Service (ATS)*
- Anexo 3 de la OACI – Servicio Meteorológico para la Navegación Aérea Internacional
- Anexo 6 de la OACI – Operación de Aeronaves
- Anexo 10 de la OACI – Telecomunicaciones Aeronáuticas – Volumen 3 Sistemas de Comunicaciones
- Anexo 11 de la OACI – Servicios de Tránsito Aéreo
- Concepción Operacional y Especificaciones Técnicas para el Centro de Control de Área Atlántico (ACC-AO - Brasil)
- Doc OACI 9694 - *Manual of Air Traffic Services “Data Link” Applications*
- Doc OACI 9776 – *Manual on VHF Digital Link (VDL) Mode 2*
- Doc OACI 9869 - *Manual on Required Communication Performance*
- Doc OACI 9896 – Manual para la Red de Telecomunicaciones Aeronáuticas (ATN) con el uso de los Protocolos y Estándares IPS
- Especificaciones Técnicas para el D-ATIS (Aeropuertos de Guarulhos y Galeão - Brasil)
- Especificaciones Técnicas para el DCL (Aeropuertos de Guarulhos y Galeão - Brasil)
- Especificaciones Técnicas para la Implantación del D-VOLMET (Brasil)
- GOLD – *Global Operational Data Link Document*
- Guía de Orientación para la Implementación de Redes Nacionales Digitales en Protocolo IP
- Guía de Orientación de Seguridad para la Implantación de Redes IP
- Plan de navegación Aérea para las Regiones Caribe y Sudamérica – FASID – Tabla CNS2A

GUIA DE ENLACE DE DATOS AIRE-TIERRA SAM

- Plan de Implantación del Sistema de Navegación Aérea Basado en Rendimiento para la Región SAM (SAM PBIP)
- Plan Mundial de Navegación Aérea para los sistemas CNS/ATM (Doc 9750) – Cuarta Edición, Iniciativa“AviationSystem Block Upgrades”- ASBU.
- Política de Enrutamiento para la Región SAM

GLOSARIO DE ACRONIMOS

- AAC Comunicaciones Aeronáuticas Administrativas – *Aeronautical Administrative Communication*
- ACC Centro de Control de Area – *Area Control Center*
- AEEC *Airlines Electronic Engineering Committee*
- ACARS *Aircraft Communications Addressing and Reporting System*
- ADS-C Vigilancia Dependiente Automática- Contrato – *Automatic Dependent Surveillance — Contract*
- ADS-B Vigilancia dependiente automática — Radiodifusión – *Automatic Dependent Surveillance – Broadcast*
- AMHS Sistema de Tratamiento de Mensajes ATS – *ATS Message Handling System)*
- ANRF Formato de Informe de Navegación Aérea – *Air Navigation Report Form*
- ANC Comisión de Navegación Aérea – *Air Navigation Comission*
- ANSP
- AOA Proveedor de Servicio de Navegación Aérea (*Air Navigation Service Provider*
ACARS over AVLC)
- AOC Comunicaciones de Control de las Operaciones Aeronáuticas – *Aeronautical Operational Communication*
- ARINC *Aeronautical Radio, Incorporated*
- ASBU Mejoras por Bloque del Sistema de Aviación – *Aviation System Block Upgrades*
- ATC Control de Tránsito Aéreo – *Aeronautical Traffic Control)*
- ATIS Servicios de Información de Vuelo – *Automatic Terminal Information Service*
Nota: D-ATIS: ATIS provisto por enlace de datos
- ATM Gestión de Tránsito Aéreo – *Air Traffic Management*
- ATN Red de Telecomunicaciones Aeronáuticas – *Aeronautical Telecommunication Network*
- ATS Servicios de Tránsito Aéreo – *Air Traffic Services*
- AVLC *Aviation VHF Link Control*

GUIA DE ENLACE DE DATOS AIRE-TIERRA SAM

- BER Tasa de Error de Bit – *Bit Error Rate*
- CAA Autoridad de Aviación Civil – *Civil Aviation Authority*
- CLNS *Connectionless Network Service*
- CPDLC Comunicaciones por Enlace de Datos Controlador-Piloto – *Controller-pilot data link communications*
- CSP Proveedor de Servicios de Telecomunicaciones (*Communication Service Provider*)
- DCL *Departure clearance*
- DSP Proveedor de Servicios de Enlace de Datos – *Data Link Service Provider*
- DECEA *Departamento de Controle do Espaço Aéreo*
- FASID *Facilities and Services Implementation Document*
- FANS *Future Air Navigation System*
- FCI Futura Infraestructura de Comunicación – *Future Communication Infrastructure*
- FIR Región de Información de Vuelo – *Flight Information Region*
- FMS *Flight Management System*
- FOM FANS 1/A *Operational Manual*
- GOLD Documento Operacional Mundial de Enlace de Datos – *Global Operational Data Link Document*
- GREPECAS Grupo Regional de Planificación e Ejecución del Caribe y Sudamérica
- HFDL Enlace de Datos por Alta Frecuencia – *High frequency data link*
- IPS Conjunto de Protocolos de la Internet – *Internet Protocol Suite*
- ISO *International Organization for Standardization*
- LAR Reglamentos Aeronáuticos Latino-Americanos
- LDACS *L-Band digital aeronautical communications system*
- MAC *Media Access Control*

GUIA DE ENLACE DE DATOS AIRE-TIERRA SAM

- MPLS *Multiprotocol Label Switching*
- OACI Organización de Aviación Civil Internacional
- OCL *Oceanic Clearance*
- OSI *Open System Interconnection*
- PFF Formatos de Objetivo de Performance – *Performance Framework Form*
- PIA Área de Mejoramiento de la Eficiencia – *Performance Improvement Area*
- PIRG *Planning and Implementation Regional Group*
- QoS Calidad de Servicio (*Quality of Service*)
- RAAC Reunión de Autoridades de Aeronáutica Civil de la Región Sudamericana
- RCP Performance de Comunicación Requerida – *Required Communication Performance*
- REDDIG Red Digital Sudamericana
- RGS *Remote Ground Station*
- RSP Performance de Vigilancia Requerida – *Required Surveillance Performance*
- RVSM Separación Vertical Mínima Reducida – *Reduced vertical separation Minima*
- SAM Región Sudamericana – *South American Region*
- SAM/IG Grupo de Implantación SAM – *SAM Implementation Group*
- SATCOM Satellite Communication
- SIGMET *Significant Meteorological Information*
- SITA *Société Internationale de Télécommunications Aéronautiques*
- SLA Acuerdo de Nivel de Servicios – *Service Level Agreement*
- SRVSOP Sistema Regional para la Vigilancia de la Seguridad Operacional
- TAF *Terminal Aerodrome Forecasts*
- TBO Operación Basada en Trayectoria – *Trajectory-Based Operation*

GUIA DE ENLACE DE DATOS AIRE-TIERRA SAM

- TCP *Transmission Control Protocol*
- VDL *Enlace de Datos VHF – VHF Data Link*
- VDL Mode 0/A o VHF ACARS *VHF data link mode 0/A subnetwork*
- VDL Mode 2 *VDL data link mode 2 subnetwork*
- VGS *VDL Ground Station*
- VHF *Muy Alta Frecuencia – Very High Frequency (30 to 300 MHz)*
- VOLMET *Información Meteorológica para Aeronaves en Vuelo
Nota: D-VOLMET: VOLMET provisto por enlace de datos*
- VPN *Virtual Private Network*
- WAN *Wide Area Network*

DEFINICIONES

Para fines de este documento, se aplican las siguientes definiciones:

Ancho de Banda: velocidad máxima de paquetes de una puerta de conexión dedicada expresada en kbit/s o Mbit/s.

Aplicaciones ATN: También conocido como ATN Baseline 1 o 2, son aplicaciones que se utilizan la red ATN, actualmente basada en el modelo OSI de la ISO y futuramente por el modleto IPS, para el intercambio de mensajes aire-tierra o tierra-tierra.

Aplicaciones FANS1/A: Aplicaciones orientadas a bit, que siguen las recomendaciones AEEC 622 - *ATS Datalink Applications over ACARS Air-Ground Network*, para las comunicaciones aire-tierra por medio de enlace de datos.

Aplicaciones PRE-FANS: Aplicaciones orientadas a carácter, que siguen las recomendaciones AEEC 623 - *Character-Oriented Air Traffic Service (ATS)*, para las comunicaciones aire-tierra por medio de enlace de datos.

Área de Mejoramiento de la Eficiencia – Performance Improvement Area (PIA): conjunto de módulos que proveen los objetivos operacionales y de performance en relación al ambiente que son aplicados, formando una visión ejecutiva de la evolución pretendida con la aplicación del ASBU. También facilita la comparación de los programas en ejecución.

Automatic Dependent Surveillance – Broadcast: Forma como una aeronave, vehículo de aeródromo y otros objetos transmiten y/o reciben datos como la identificación, posición y datos adicionales utilizándose un enlace de datos con radiodifusión.

Automatic Dependent Surveillance – Contract (ADS-C): Forma de intercambio de mensajes de ADS-C por medio de un enlace de datos aire-tierra que especifica bajo qué condiciones el informe ADS-C debiera ser iniciado y cuál sería el contenido involucrado en los informes.

Calidad de Servicio – Quality of Service (QoS): El término Calidad de servicio hace referencia a una cantidad de tecnologías, que pueden identificar el tipo de datos que contiene un paquete y dividir los paquetes en clases de tráfico para priorizar su reenvío. Las ventajas principales de una red sensible a la QoS son la priorización del tráfico para permitir que flujos importantes se gestionen antes que flujos con menor prioridad, y una mayor fiabilidad de la red, ya que se controla la cantidad de ancho de banda que puede utilizar cada aplicación y, por lo tanto, la competencia entre aplicaciones en el uso del ancho de banda.

Capa Física (Nivel1): La capa física define las características técnicas de los dispositivos eléctricos y ópticos (físicos) del sistema. Ella contiene los equipamientos de cableado u otros canales de comunicación que se comunican directamente con el controlador de interfaz de red. Se ocupa, por tanto, en permitir una comunicación simple y confiable, en la mayoría de los casos con control de errores básicos:

Funciones de la Capa:

- Mueve bits (o bytes, conforme a la unidad de transmisión) a través de un medio de transmisión;
- Define las características eléctricas y mecánicas del medio, la tasa de transferencia de los bits, tensiones, etc.
- Ejecuta o controla la cantidad y velocidad de transmisión de las informaciones de la red.

No es función del nivel físico tratar problemas como los errores de transmisión, ya que ellos son tratados por las otras capas del modelo OSI.

Capa de Red (Nivel 3): La capa de Rede responsable del direccionamiento de los paquetes en la red, también conocidos como datagrama, asociando direcciones lógicas (IP) a direcciones físicas, de forma que los paquetes de red consigan llegar correctamente a destino. Esta capa también determina la ruta que los paquetes irán a seguir para arribar a destino, basada en factores como condiciones de tráfico de red y prioridades.

La referida capa es usada cuando la red posee más de un segmento y, por ello, habrá más de un camino para un paquete de datos para corre del origen al destino.

Funciones de la Capa:

- Mueve paquetes a partir de su fuente original hasta su destino a través de uno o más enlaces.
- Define como los dispositivos de red se descubren unos a otros y como los paquetes son ruteados hasta su destino final.

Clearance. Autorización para que una aeronave proceda bajo las condiciones especificadas por una unidad de control de tránsito aéreo.

Disponibilidad: parámetro de medición del desempeño que consiste en el porcentaje de tiempo en el cual el PP/nodo (según corresponda) está operacional, en un periodo determinado de prestación del servicio.

Enrutador: equipo dotado de capacidad de procesamiento IP, con la función de determinar las rutas a través de las cuales los paquetes deben ser encaminados.

Media Access Control (MAC): es un término utilizado en redes de computadoras para designar parte de la camada de enlace, camada número 2 según el modelo OSI. Es proveedora del acceso a un canal de comunicaciones y por el direccionamiento en este canal posibilitando la conexión de diversas computadoras en una red.

METAR: Informe regular de meteorología de aeródromo. Es utilizado para las descripciones completas de las condiciones meteorológicas observadas en espacios regulares de tiempo de una hora.

Protocolo de Enrutamiento: son aquellos utilizados entre enrutadores para el intercambio de informaciones sobre la topología de la red. Permiten la actualización de la tabla de enrutamiento, que es usada pelos enrutadores para elegir el mejor camino para enviar un paquete entre los segmentos de la red.

Red ATN: Arquitectura de red que permite que haya el intercambio de informaciones aire-tierra o tierra/tierra con fines ATS y con el uso de los protocolos ISO o IPS.

Red REDDIG: Red de Telecomunicaciones Aeronáuticas de la Región SAM (ATN SAM), que soporta los actuales requerimientos fijos aeronáuticos de voz y datos, el intercambio de datos radar y planes de vuelo, así como las nuevas aplicaciones ATN tierra – tierra entre los Estados / Territorios de la Región SAM, previstas a implantarse, a corto y mediano plazo. La REDDIG está en fase de modernización y será llamada de REDDIG II.

Retardo (o latencia): parámetro de medida del desempeño del servicio, que consiste en el tiempo medio de tránsito de un paquete de 64 *bytes* entre dos PP de la Contratante.

SPECI: Informe especial de meteorología de aeródromo. Es utilizado cuando ocurre una o más variaciones significativas en las condiciones meteorológicas entre intervalos de tiempo regulares de una hora.

SIGMET: Mensaje meteorológico que consiste de una descripción concisa, clara, abreviada relativa a la ocurrencia y/o previsión de fenómenos meteorológicos en ruta que puedan afectar la seguridad de las operaciones aéreas en una determinada FIR.

TAF (*Terminal Aerodrome Forecasts*): prevision de las condiciones meteorológicas para un determinado aeródromo.

1. INTRODUCCION

1.1 Antecedentes

En 1983, la Organización de Aviación Civil Internacional (OACI) estableció el comité especial para el desarrollo de lo que se llamó *Future Air Navigation System* (FANS) con respecto a conceptos operacionales nuevos para la aplicación en la Gestión de Tránsito Aéreo (ATM). El informe del FANS fue publicado en 1988 y creó la base para que la industria estableciese la estrategia para la ATM con el uso tecnologías digitales basadas en enlace de datos y transmisiones por satélite.

En la década de 1990, las empresas Boeing y Airbus ya habían desarrollado equipos y *softwares* para la utilización de aplicaciones ATS, tales como el *Controller–Pilot Data Link Communications* (CPDLC) y el *Automatic Dependent Surveillance* (ADS), principalmente con la utilización de comunicaciones por satélite en áreas oceánicas.

La utilización de enlaces de datos para fines de los Servicios de Tránsito Aéreo (ATS) tuvo un considerable impulso por la utilización de la plataforma *Aircraft Communications Addressing and Reporting System* (ACARS) que fue un sistema desarrollado por la empresa *Aeronautical Radio, Incorporated* (ARINC) para la transmisión de pequeñas y simples mensajes entre las aeronaves y las empresas aéreas, sistema que sufrió adaptaciones para que pudiera transmitir los mensajes de interés del control de tránsito aéreo también con la utilización de equipos de Muy Alta Frecuencia (VHF) y de Alta Frecuencia (HF).

Con respecto a la documentación de la OACI para el soporte a la instalación de infraestructuras de enlace de datos, fue desarrollada una serie de documentos preparados para utilidades en la Región *Asia-Pacific*-(APAC) y *European and North Atlantic Region* (EUR-NAT), en especial el Documento Operacional Mundial de Enlace de Datos (*Global Operational Data Link Document*) - GOLD. La Segunda edición del GOLD fue aprobada en abril de 2013 con la intención de extender el alcance de los enlaces de datos tierra-aire para la utilización de forma armonizada globalmente.

Otro punto que merece destaque es que el GOLD describe en que situaciones se deben utilizar las más variadas tecnologías en términos operacionales, pero no puede ser considerada una guía de como un ANSP puede implantar la infraestructura de comunicaciones y los sistemas que soportan las aplicaciones de enlaces de datos. En ese sentido, el presente documento busca proporcionar líneas generales que puedan ser seguidas por los ANSP y/o Autoridades Aeronáuticas SAM en la implementación de sus enlaces de datos.

Si bien ya existen una serie de actividades en marcha en la Región SAM para la implantación de enlace de datos, se debe mencionar que todo empezó con iniciativas que decían respecto a las Regiones de Caribe y América Central (CAR) y SAM en conjunto.

Así, cabe notar las efectivas acciones en una secuencia de eventos en los últimos años que impulsan el desarrollo de la implantación de enlace de datos en ámbito regional.

GUIA DE ENLACE DE DATOS AIRE-TIERRA SAM

En ese sentido, se nota que en la Primera Reunión del extinto Subgrupo CNS/ATM (CNS/ATM/SG/1) del Grupo Regional de Planificación e Ejecución del Caribe y Sudamérica (GREPECAS), que se llevó a cabo en la Ciudad de Lima – Perú, del 15 al 19 del mes de marzo de 2010, se decidió por la forma de trabajo bajo la gestión de programas y proyectos en lugar de la utilización de grupos de trabajo a fin de asegurar una mejor coordinación en materias ATM y CNS y desarrollar una planificación CAR/SAM basada en la performance, con miras a la implantación del Sistema de Gestión de Tránsito Aéreo (ATM) mundial.

Dentro del Programa de Infraestructura de Comunicaciones Tierra-Tierra y Aire-Tierra se encontraban dos proyectos que eran:

- a) Arquitectura de la ATN CAR/SAM (D1); y
- b) Aplicaciones tierra-tierra y tierra-aire de la ATN (D2).

En la reunión GREPECAS/16, realizada en la ciudad de Punta Cana, República Dominicana, del 28 de marzo al 1° de abril de 2011, fue decidido que los proyectos deberían ser conducidos independientemente por región, CAR o SAM. Resulta ser que todo lo que estaba siendo hecho dentro del Subgrupo CNS/ATM para las Regiones CAR/SAM, en conjunto, fue dividido en forma separado CAR y SAM.

Para llevar adelante los trabajos de la nueva organización del GREPECAS, fue creado el Comité de Revisión de los Programas y Proyectos (CRPP), el cual tiene la función de elaborar los informes anuales del GREPECAS a ser aprobados por dicho Grupo utilizando el procedimiento expreso, para luego ser presentados por la Secretaría a la Comisión de Navegación Aérea (ANC), para su posterior presentación al Consejo, de ser el caso.

En términos prácticos, en lo que concierne a enlace de datos, fue creado, en la Séptima Reunión del Grupo de Implantación SAM (SAM/IG/7), sucedida en Lima – Perú del 23 al 27 de mayo de 2011, el Proyecto de Aplicaciones Tierra-Tierra y Tierra-Aire de la ATN (D2) para la Región SAM.

Entre las tareas asignadas al Proyecto D2 está la elaboración de una guía de orientación sobre la implantación de aplicaciones de enlaces de datos aire-tierra en la Región SAM, previsto en el marco de las actividades del Proyecto Regional RLA/06/901 – Asistencia para la implantación de un sistema regional de ATM considerando el concepto operacional de ATM y el soporte de tecnología en comunicaciones, navegación y vigilancia (CNS) correspondiente.

Cabe resaltar que para la elaboración de la guía también se considera la experiencia de Brasil en la implementación de enlace de datos, conforme reflejado en la tabla de descripción de las tareas referentes al Proyecto D2. En especial, se aporta las principales características y necesidades suplidas en la implantación de aplicaciones orientadas a carácter, como: Información Meteorológica para Aeronaves en Vuelo por Enlace de Datos (D-VOLMET), *Departure clearance* por Enlace de Datos (DCL) y Servicios de Información de Vuelo por Enlace de Datos (D-ATIS), además de la adopción de enlace de datos para las comunicaciones en la FIR oceánica, llamada de ACC Atlántico (ACC-AO), con la utilización de Comunicaciones por Enlace de Datos Controlador-Piloto (CPDLC) y de Vigilancia Dependiente Automática- Contrato (ADS-C).

Para finalizar, es oportuno mencionar que esta guía puede ser considerada un documento vivo que deberá sufrir actualizaciones periódicas, a lo largo del tiempo, llevándose en cuenta las muchas iniciativas recurrentes globales sobre el tema y los esfuerzos de los Estados de la Región SAM y de la Oficina Regional de Lima la OACI para la adopción del Plan de Implantación del Sistema de Navegación Aérea Basado en Rendimiento para la Región SAM (SAM PBIP), en consonancia a los nuevos conceptos de Mejoras por Bloque del Sistema de Aviación (ASBU), presentado y aprobado en la Duodécima Conferencia de Navegación Aérea (AN-Conf/12), que se llevó a cabo en la Ciudad de Montreal – Canadá del 19 al 30 de noviembre de 2012.

1.2 Alcance del documento

La presente guía está dirigida a los Proveedores Nacionales de Servicios de Navegación Aérea (ANSP), Autoridades de Aeronáutica Civil y Operadores de Aeronaves, de la Región Sudamericana de la OACI– (SAM), que requieran información introductoria sobre conceptos y consideraciones técnicas operacionales, que deberían tenerse en cuenta, antes de la planificación e implementación de enlaces de datos tierra-aire en la región.

No es objetivo de la presente guía los lineamientos que pudieran ser seguidos por los Estados para la implantación de enlaces de datos aire-tierra para la aplicación de ADS-B, como sensor de vigilancia ATS o como sistema de monitoreo de tránsito de abordaje, para la mejora de la conciencia situacional de las tripulaciones. Para este propósito fue elaborada y presentada, en la reunión SAM/IG/10, ocurrida del 1^o al 5 de octubre de 2012, la Guía de consideraciones técnicas operacionales para la implantación del ADS-B en la región SAM, como parte de las tareas del Proyecto Mejora a la Comprensión Situacional ATM SAM del Programa de Automatización y Comprensión Situacional.

1.3 Organización del documento

La parte inicial de este documento es compuesta de las Referencias, del Glosario de Acrónimos y de las Definiciones que funcionan como una referencia para todo el documento, teniéndose en cuenta la gran cantidad de informaciones presentes en el contenido del documento. Completando esta parte, se introduce, en la Sección 1.1 de Antecedentes del Capítulo 1, un histórico de todas las actividades para impulsar el uso del enlace de datos en las regiones de la OACI, en especial en la Región SAM.

En el Capítulo 2, son presentadas las consideraciones básicas para la implantación de enlace de datos aire-tierra, en particular los lineamientos del nuevo Plan mundial de navegación aérea, 4^a Edición (GANP) (Doc 9750) a la nueva metodología de la OACI llamada Mejoras por Bloque del Sistema de Aviación (ASBU), además de la revisión del Plan de Implantación del Sistema de Navegación Aérea Basado en Rendimiento para la Región SAM (SAM PBIP) alineado al ASBU.

También en el Capítulo 2, son sugeridas infraestructuras de telecomunicaciones básicas para la transmisión de las informaciones hacia una dependencia de Control de Tránsito Aéreo (ATC), tomándose en cuenta, principalmente las subredes de aire-tierra con las tecnologías satelitales y terrestres, la subred de tierra entre las estaciones remotas y las dependencias ATC, tomándose por base los rigurosos requisitos de disponibilidad, confiabilidad y integridad presentes en las de la OACI.

En el Capítulo 3 se agrega la experiencia de Brasil para la implantación de las aplicaciones de CPDLC y ADS-C en el Centro de Control de Área Atlántico (ACC-AO), que es responsable por las operaciones de la Región de Información de Vuelo (FIR) oceánica del país.

Teniéndose en cuenta la importancia de las aplicaciones PRE FANS, se introduce, en el Capítulo 4, las características básicas las aplicaciones orientadas a carácter de D-VOLMET, D-ATIS y *Departure clearance* (DCL). En todos los casos descriptos fueron tomadas en consideración las experiencias de Brasil en la implementación de los referidos servicios.

Finalmente, en el Capítulo 5 se hace un resumen de todo el contenido de la guía sobre las consideraciones que deberían ser llevadas en cuenta por los Estados en la hora de implementar enlaces de datos.

GUIA DE ENLACE DE DATOS AIRE-TIERRA SAM

2. **CONSIDERACIONES GENERALES EN LA REGION SAM PARA LA IMPLANTACIÓN DE ENLACES DE DATOS AIRE-TIERRA**

2.1 **Introducción**

La Figura 1 presenta como las aplicaciones de enlace de datos son importantes en todas las fases de vuelo, desde el despegue hasta el aterrizaje.

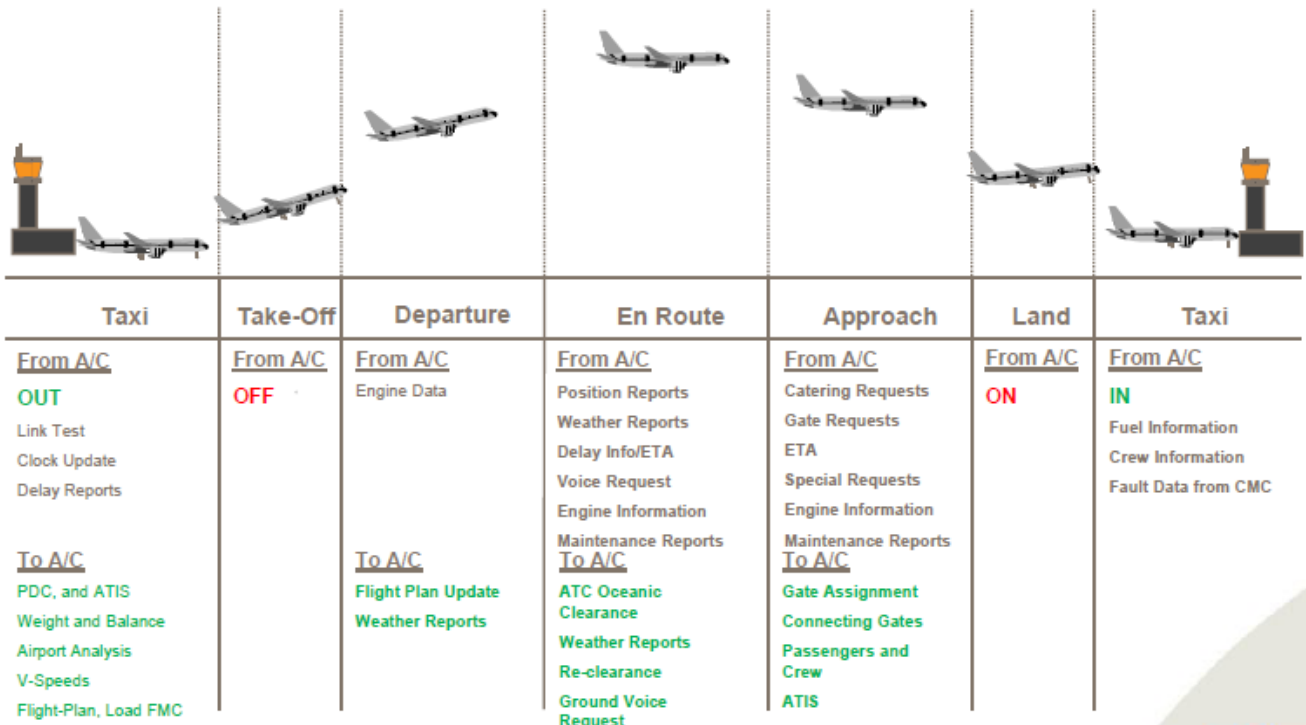


Figura 1: Aplicaciones de Enlace de Datos Tierra-Aire

En América del Sur se observa un acentuado aumento de la actividad de tránsito aéreo, debido al crecimiento económico y del turismo de la Región Sudamericana (SAM).

Con eso las autoridades civiles de la región hacen considerables inversiones en las infraestructuras de soporte a las actividades de control de tránsito aéreo (ATC) con fines de proporcionar los mejores servicios para satisfacer las proyecciones del aumento de movimientos.

Una de las infraestructuras que deben ser modernizadas o implantadas esa la capacidad de comunicaciones tierra-aire, con la adopción del concepto de enlace de datos (*data-link*), en sustitución a las tradicionales comunicaciones orales entre pilotos y controladores de tránsito aéreo.

Los servicios de enlace de datos tienen el objetivo de soportar la gestión más eficiente del tránsito aéreo con fines de proporcionar una capacidad más optimizada del espacio aéreo. Con esto, se puede hacer la reducción de las separaciones longitudinales y laterales entre aeronaves.

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La principal aplicación de comunicación entre piloto y controlador es el CPDLC, que tiene las ventajas de reducir la congestión de los tradicionales canales de voz y de posibilitar el uso de los recursos de automatización. Además de esto, proporciona la disminución de los problemas de comunicación y la carga de trabajo de controladores y pilotos.

Los componentes tecnológicos para el trámite de los mensajes vía el enlace de datos se dividen en subred de aire compuesta de los equipos instalados en las aeronaves (aviónicos), el medio de comunicación aire-tierra, las subredes de comunicaciones de tierra y por los usuarios que harán uso de las informaciones (empresas aéreas, dependencias ATC, etc.).

Para la elección de la plataforma que será adoptada, la decisión pasa por cuestiones operacionales, técnicas, financieras y estratégicas de las Autoridades de Aviación Civil e/o Proveedores Nacionales de Servicios de Navegación Aérea (ANSP).

Con esto, es necesario desarrollarse, por parte de los Estados y/o ANSP una política que viabilice inversiones necesarias y todo empieza por la elaboración de una Concepción Operacional de la ATM Nacional del Estado y que se divide en los planes operacionales para la implantación de la infraestructura de tierra e incentivo a los explotadores para que equipen sus aeronaves.

Como se indica en los próximos capítulos, la tecnología por transmisión por satélite, llamada de SATCOM, y los radios VHF analógicos (ACARS) son capaces de transmitir una gran cantidad de aplicaciones de enlace de datos orientadas a carácter o a *bit* en las áreas oceánicas y/o remotas continentales. Asimismo, es posible el uso del *High frequency data link* (HF DL), conforme previsto en el Anexo 10 de la OACI – Telecomunicaciones Aeronáuticas – Volumen 3 Sistemas de Comunicaciones.

Sin embargo, si es necesario la adopción de la aplicación CPDLC en el área continental con considerable densidad de tráfico aéreo, no es posible el empleo de las referidas tecnologías en el párrafo anterior, necesitándose la instalación del estándar previsto en el Doc OACI 9776 – *Manual on VHF Digital Link (VDL) Mode 2*, o sea, el radio VHF *data-link* Mode 2 (VDL Mode 2) y enrutadores de la Red de Telecomunicaciones Aeronáuticas (ATN), lo que representa una considerable inversión por parte de las empresas aéreas y del ANSP.

Un factor que merece considerable atención es la planificación regional para la implantación de enlace de datos en la Región Sudamericana (SAM), conforme detallado en Plan de Implantación del Sistema de Navegación Aérea Basado en Rendimiento para la Región SAM (SAM PBIP), que fue aprobado en la Duodécima Reunión de Autoridades de Aeronáutica Civil de la Región Sudamericana (RAAC/12) que se celebró en Lima, Perú, del 3 al 6 de octubre de 2012.

Para reforzar las iniciativas, en la Duodécima Conferencia de Navegación Aérea (AN-Conf/12) se aprobó la nueva metodología de la OACI llamada Mejoras por Bloque del Sistema de Aviación (ASBU), la cual será parte del nuevo Plan mundial de navegación aérea, 4ª Edición (GANP) (Doc 9750) y a través de la Recomendación 6/1 - Marco de actuación regional – metodologías y herramientas de planificación, se aprueba que los Estados y los Grupos de Planificación Regional (PIRG) finalicen la armonización de los planes regionales con el GANP, concentrando la atención hacia la implantación de los módulos del Bloque 0 del ASBU.

A este respecto, la Oficina Regional de Lima de la OACI procedió a la revisión del SAM PBIP con el fin de alinearlo con el ASBU. Se revisaron los 18 módulos del Bloque 0 y se consideró que, para la Región SAM, se aplicarían, en principio, 15 módulos.

Al analizar el contenido de los módulos del Bloque 0 del ASBU considerados, se observó que prácticamente todos los elementos contenido estaban contemplados en el SAM PBIP y se procedió a relacionar los objetivos de rendimiento regional con los módulos del ASBU considerados.

A este respecto, se presenta, en el **Apéndice A** de esta guía, el Módulo B0-TBO que define los aspectos para la implantación de enlace de datos para la Región SAM desde el año de 2013 hasta el año de 2018 (Bloque 0) en apoyo al Área 4 de Mejoramiento de la Eficiencia – *Performance Improvement Area* (PIA): **Trayectorias de vuelo eficientes mediante operaciones basadas en las trayectorias**. Es posible notarse la importancia dada al ADS-C en áreas oceánicas e continentales remotas, bien como el CPDLC ya aplicado a las áreas continentales.

En el **Apéndice B** aparecen los Formatos de Objetivo de Performance (*Performance Framework Form*) que tienen relación directa con la implantación de enlaces de datos en la Región SAM, que fueron integrados al SAM PBIP revisado. Debe ser notado que los enlaces de datos aire-tierra contribuyen para tres PFF (SAM ATM/06, SAM CNS/02 y SAM CNS/04).

Como mencionado, dentro del Bloque 0 del ASBU hay el Módulo B0-TBO Operación Basada en Trayectoria – *Trajectory-Based Operation*. Para el monitoreo de la implantación de enlace de datos que apoyan al módulo, fue desarrollado por la OACI un Formato de Informe de Navegación Aérea (ANRF) que está presentado en el **Apéndice C**.

Se debe mencionar que todas las iniciativas para la implantación de enlace de datos SAM está alineada con la Hoja de Ruta de Comunicaciones del ASBU, presente en el **Apéndice D**, donde se nota una presencia importante del componente de enlace de datos por medio de VHF ACARS, SATCOM (ACARS) y VDL Mode 2, basado en el Modelo *Open System Interconnection* (OSI) de la *International Organization for Standardization* (ISO) – Red ATN/OSI hasta, por lo menos, el fin del ciclo del Bloque 2 (2023 a 2028). A partir de ese punto, se empieza el uso masivo de la tecnología *L-Band digital aeronautical communications system* (LDACS), que corresponde a la infraestructura Futura de Comunicaciones (FCI), basada en el Conjunto de Protocolos IP (IPS) – ATN/IPS.

2.2 Características básicas de enlace de datos

Para la transmisión de las informaciones tierra-aire, es necesario el empleo de una estructura de telecomunicaciones que depende del lugar donde sobrevuela el avión: si es en el área oceánica, la tecnología más utilizada son los enlaces satelitales, pero también se puede emplear el *High frequency data link* (HFDL) ; caso la aeronave esté volando en un área continental es posible la utilización de las tecnologías satelital y terrestre, contemplando el HFDL, el VHF ACARS, el VDL *Mode 2* y, también, el SATCOM. Teniéndose en cuenta las tecnologías más aplicables actualmente, esta guía tratará de la utilización del VDL y del SATCOM.

Nota: El Anexo 10 de la OACI – Telecomunicaciones Aeronáuticas – Volumen 3 Sistemas de Comunicaciones contempla la posibilidad del uso del VDL *Mode 3* (datos y voz) y VDL *Mode 4* para datos. Sin embargo, los referidos equipos no tuvieron, a la fecha, aceptación por arte de los ANSP y/o Proveedor de Servicios de Enlace de Datos – *Data Link Service Provider* DSP.

La Figura 2, describe una estructura básica de telecomunicaciones, ya mencionada en la Sección 2.1 Introducción, para la transmisión de datos del avión hacia una dependencia ATC o la dirección de una empresa aérea y vice-versa.

Cabe notar que si las aplicaciones que serán transmitidas son orientadas a carácter (PRE FANS) u orientadas a bit (FANS 1/A), las arquitecturas que podrán ser utilizadas para la porción aire-tierra son: SATCOM, ACARS, HFDFL y VDL *Mode 2*. Esto podría llevar a una falsa conclusión de que las tecnologías descritas satisfacen a todos los requisitos de performance para enlace de datos. Pero el ACARS tiene una serie de limitaciones intrínsecas al sistema, como será visto más adelante en la Sección 2.5.3 e indicados en el Documento FANS *Operational Manual*, que impiden su utilización en todos los casos de enlace de datos.

Por ejemplo, con la transmisión de la aplicación de CPDLC en áreas continentales con gran densidad de movimientos de tránsito aéreo, se hace imprescindible la adopción del VDL *Mode 2* y equipos de capa 3 (enrutadores), constituyendo, de esta forma, una red ATN.

GUIA DE ENLACE DE DATOS AIRE-TIERRA SAM

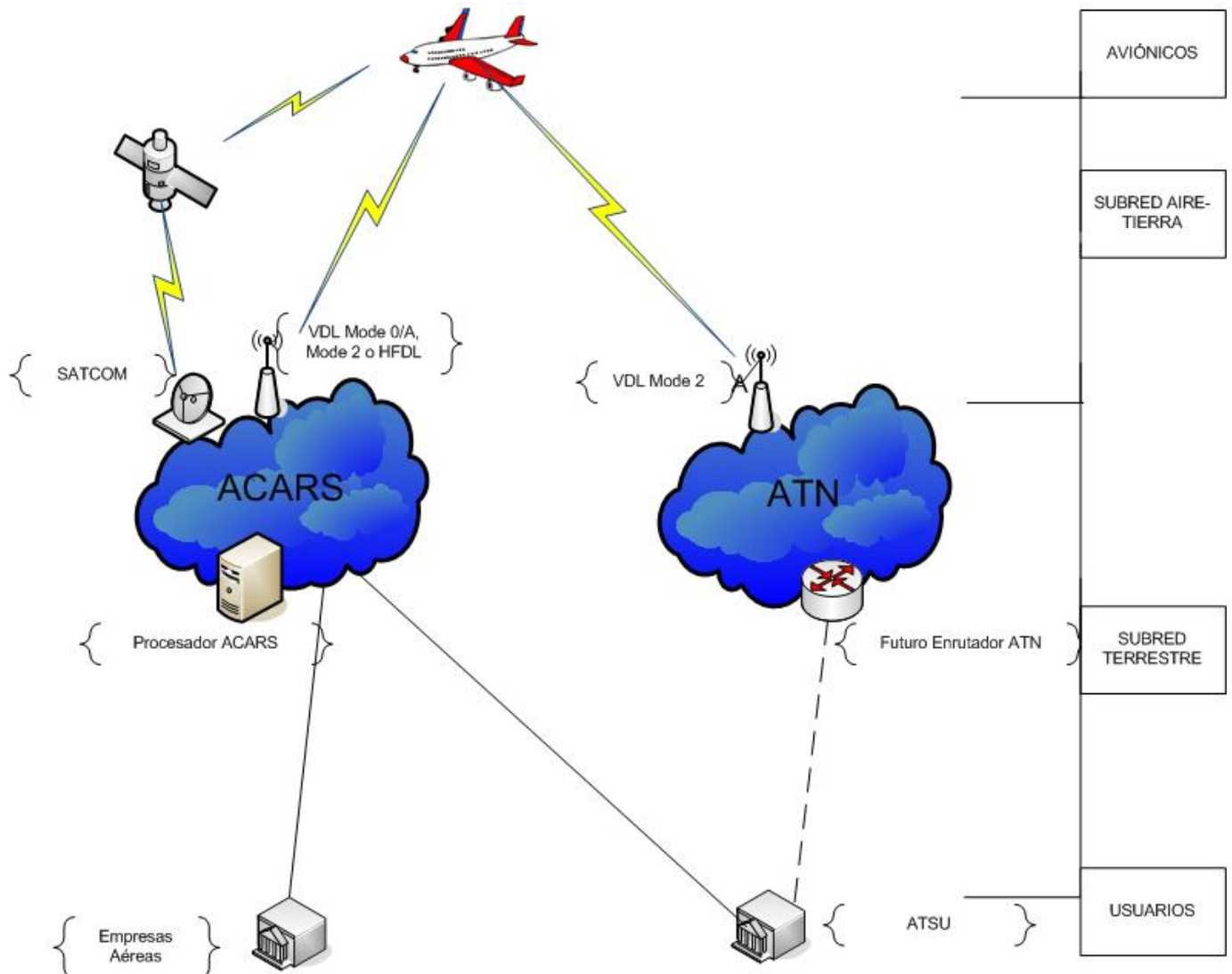


Figura 2 Infraestructura de Básica de Telecomunicaciones Tierra-Aire

Debe ser notado, en la Figura 2, que hay muchos sistemas y equipos entre el avión y una dependencia ATC o AOC de tierra y esto afecta, de modo problemático, la disponibilidad fin a fin.

A este respecto, es conveniente notar que en telecomunicaciones y en la teoría de la confiabilidad, el término disponibilidad indica el grado de operatividad de un sistema, o subsistema, cuando es necesario su funcionamiento. De forma simplificada, sin entrar en cálculos matemáticos con respecto al tema, disponibilidad representa la probabilidad de que en un instante cualquiera el sistema se encuentre en condiciones de “trabajar”.

Como se está tratando de probabilidad, debe tenerse en cuenta que equipos en paralelo aumentan la disponibilidad, mientras en serie la disminuye. En el **Apéndice E** son presentados algunos conceptos de disponibilidad de sistemas ligados a las redes de comunicaciones que soporten las transmisiones de las señales descritas en la Figura 2.

Todo lo que fue descrito representa una importancia muy grande, pues cuando se habla de comunicaciones de datos hay que tener en cuenta la tecnología empleada para que se alcance la disponibilidad adecuada.

La OACI posee algunas provisiones que tratan del asunto en detalles. El Doc 9694 - *Manual of Air Traffic Services "Data Link" Applications* presenta importantes conceptos en la adopción del enlace de datos para los servicios ATS. Para tal, describe las principales aplicaciones que usan enlaces de datos: CPDLC, ADS-C, ADS-B, entre otras. También presenta los principales requerimientos de performance en términos de disponibilidad, integridad, continuidad y confiabilidad para cada aplicación.

Sin embargo, se puede considerar que un impulso considerable fue la adopción del Doc 9869 *Manual on Required Communication Performance* que describe el concepto de *Required Communication Performance* (RCP) y asocia las aplicaciones a tiempos de transacción de mensajes, disponibilidad, continuidad e integridad con fines de apuntar cuales son las separaciones longitudinales y laterales ideales para cada espacio aéreo.

El concepto de RCP evalúa las comunicaciones operacionales en términos de las funciones ATM, tomando en cuenta los factores humanos, procedimientos y características ambientales. En verdad, el desarrollo de los conceptos del RCP fue la necesidad de obtener criterios operacionales para evaluar las tecnologías disponibles para las comunicaciones completas entre controladores y pilotos.

Por extensión, fueron adoptados tipos para el RCP que definen estándares de desempeño operacionales en términos de tiempo de transacción de los mensajes, continuidad, disponibilidad e integridad aplicables a los más estrictos requisitos de operación ATM. Cabe decir que hay tipos de RCP, como el 10, para los cuales están siendo desarrollados equipos de comunicaciones y procedimientos que contemplen las exigencias correspondientes.

Por otro lado, el documento GOLD utiliza los conceptos presentes en el Doc 9869 teniendo en cuenta las tecnologías disponibles para operaciones en el área oceánica o continental remota. Además, incorpora los conceptos de *Required Surveillance Performance* (RSP) principalmente para las operaciones en el área oceánica.

En este punto se considera conveniente hacer algunos comentarios con respecto a las nomenclaturas utilizadas en el documento GOLD para los equipos de la Subred Aire-Tierra. De hecho, en Europa y en los Estados Unidos hay una serie de iniciativas para la implantación de enlace de datos, lo que justifica la diferenciación de aplicaciones y tecnologías con muchas terminologías. En Sudamérica, la velocidad de implantación de enlace de datos no es tan intensa y se considera que no sea necesario hacerse tantas diferenciaciones en los tipos de tecnologías y aplicaciones.

Así, en términos de las tecnologías de transmisión aire-tierra, el GOLD se refiere al VHF analógico como VDL Mode 0/A y en este documento se utilizará la indicación VHF ACARS.

Con respecto a las aplicaciones orientadas a carácter, documento GOLD llama estas aplicaciones como ACARS ATS, la misma nomenclatura del AEEC 623 *Character-Oriented Air Traffic Service Applications*. En esta guía, se referirá a las referidas aplicaciones como PRE-FANS para evitar posibles confusiones con los radios VHF ACARS. Por otro lado, la implantación de una red ATN con la utilización de VDL Mode 2, con la finalidad de transmisión de CPDLC en el área continental de gran densidad de movimientos, es considerada como ATN *Baseline 1* (ATN B1) en el GOLD. En esta guía será considerada como Red ATN.

Nota: En Europa el ATN *Baseline 1* es tratado como Link 2000+ bajo la coordinación del EUROCONTROL para la implementación del *Single European Sky ATM Research* (SESAR).

Cabe decir que hay otras nomenclaturas en vigor, como el ATN *Baseline 2* (ATN B2), que posibilitará la implementación de los procedimientos de Trayectorias 4D, que comprende trayectorias basadas en longitud, latitud, altitud y tiempo. Asimismo, el ATN *Baseline 2* dará soporte a todas las demás aplicaciones existentes hoy en día, pero mejoradas técnicamente. Sin embargo, los procedimientos involucran nuevas tecnologías de enlace de datos y están previstas para los Bloques 3 y 4 del ASBU.

2.3 Equipos de bordo

El Apéndice F del documento GOLD describe las informaciones específicas con respecto a los equipos disponibles para aplicación en las aeronaves de los más variados fabricantes y sus respectivos aviones para soportar los enlaces de datos. Teniéndose en cuenta las actualizaciones necesarias que deberán ser hechos en el documento de referencia, no se repetirá, en esta guía, las informaciones del contenido en el referido apéndice.

Los principales componentes de bordo para la realización de enlace de datos están ilustrados en la Figura 3.

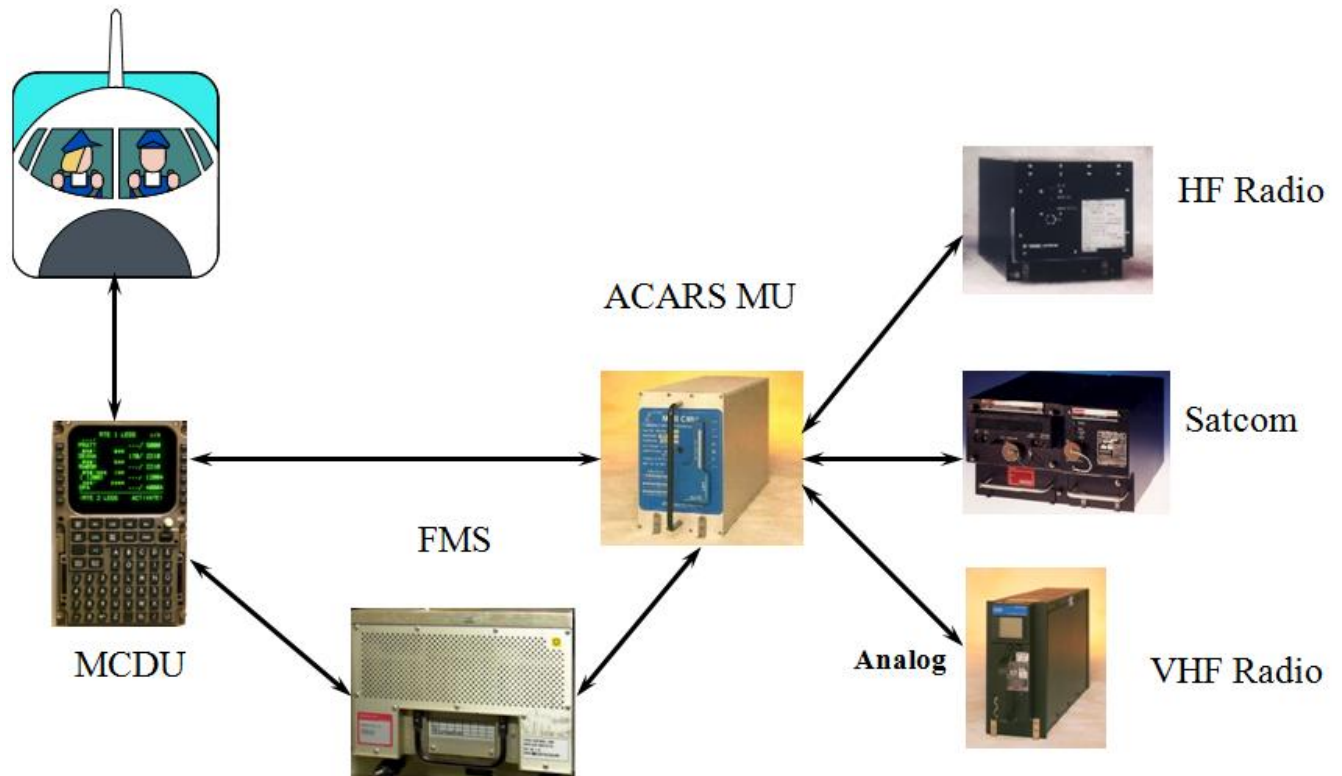


Figura 3: Sistema de Bordo para Enlace de Datos

En líneas generales los mensajes de *up* y *downlink* son insertadas en el *Multi-Function Control Display Unit* (MCDU). Los equipos transceptores son seleccionados, así como las frecuencias, por intermedio del *ACARS Management Unit* (MU). Cabe resaltar que el MU también está ligado al *Flight Management System* (FMS) que obtiene las informaciones de posición de la aeronave. Además de eso, el sistema también se compone de las antenas e impresoras.

Aun cuando la Figura 3 está relacionada al sistema ACARS, cuando se tenga el ATN habrá equipos semejantes con la adición de enrutadores ATN y de radios digitales *VDL Mode 2*.

2.4 Infraestructura tierra-aire

2.4.1 Introducción

Cuando se habla de comunicaciones aire-tierra, es importante identificar los tipos de flujos de mensajes que son transferidos de la aeronave hacia un ATSU y vice-versa:

- Flujos ACARS (AAC/AOC): los datos son transmitidos entre la aeronave y las empresas aéreas con fines de intercambio de mensajes administrativos y operacionales;
- Flujos ACARS (ATC): los datos son transmitidos entre la aeronave y un ATSU y pueden ser mensajes FANS o PRE-FANS; y

- Flujos ATN: los datos son transmitidos por la aeronave hacia un ATSU con la utilización de VDL *Mode 2* y con la utilización de enrutadores ATN.

Actualmente hay tres tipos de redes aire-tierra principales:

- VHF que utiliza la señal en VHF entre el avión y una estación de tierra, pudiendo ser el VHF ACARS (VDL *Mode 0/A*) o el VHF estandarizado por la OACI (VDL *Mode 2*);
- SATCOM ACARS: la señal pasa de la aeronave al satélite y, después, se transmite hacia una estación terrena; y
- HF ACARS: introducido posteriormente y usa una señal en HF entre la aeronave y una estación HF de tierra.

La mayoría de las aeronaves que operan en Sudamérica están equipadas con el sistema de comunicación *Aircraft Communications Addressing and Reporting System* (ACARS) y en el futuro se pretende instalar equipos para la adopción de las comunicaciones controlador/piloto con el uso de la Red de Telecomunicaciones Aeronáuticas (ATN), que es el estándar previsto por la OACI y que posibilita la implantación del CPDLC en áreas continentales con grandes movimientos de tránsito aéreo.

Como informado anteriormente, se enfatiza que los mensajes ACARS utilizan los enlaces analógicos VHF para la transmisión de aplicaciones orientadas a carácter, con base en la especificación AEEC 623-2, u orientadas a bit, con la utilización de la conversión carácter/bit prevista en la especificación AEEC 622-3.

En la Figura 2, aparece la Red del Proveedor (CSP) que puede ser considerada como aquella que conecta las estaciones que reciben los datos provenientes de las estaciones SATCOM, HF DL y VHF (ACARS o VDL *Mode 2*) y las disponen a las empresas aéreas o a un ATSU. Las secciones siguientes describirán los principales aspectos de las redes aire-tierra, con el uso de VHF, y terrestres para soporte al intercambio de mensajes enlace de datos entre las aeronaves y los usuarios.

Como está reflejado en documento GOLD, prácticamente todas las aeronaves están equipadas para la utilización de data-link por medio de VHF, mientras ni todas lo están para las comunicaciones por intermedio de SATCOM y/o HF. Además de eso, hay ANSP que no permiten la utilización de medios de comunicación como el SATCOM y/o HF.

2.4.2 **Redes de comunicaciones tierra-airre (VHF)**

2.4.2.1 **General**

Como comentado, se enfatiza que esta guía está orientada a la instalación de equipos VHF como parte de la implantación de la subred aire-tierra. A este respecto, en la fase de planificación del sistema VHF es necesario establecer el nivel asociado a la cobertura de VHF para todo el área continental de actuación de un Estado.

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Como ejemplo, en la modernización de la infraestructura de enlace de datos de Brasil, se adoptó la cobertura en todo el espacio aéreo brasileño a partir del *flight level 245* (FL 245), que representa la frontera para el espacio aéreo superior. La Figura 4 ilustra la cobertura VHF para enlace de datos que será implantada en Brasil hasta el año de 2016, donde los círculos rojos representan la cobertura actual y los azules la que será implantada para completar la cobertura en el FL 245.

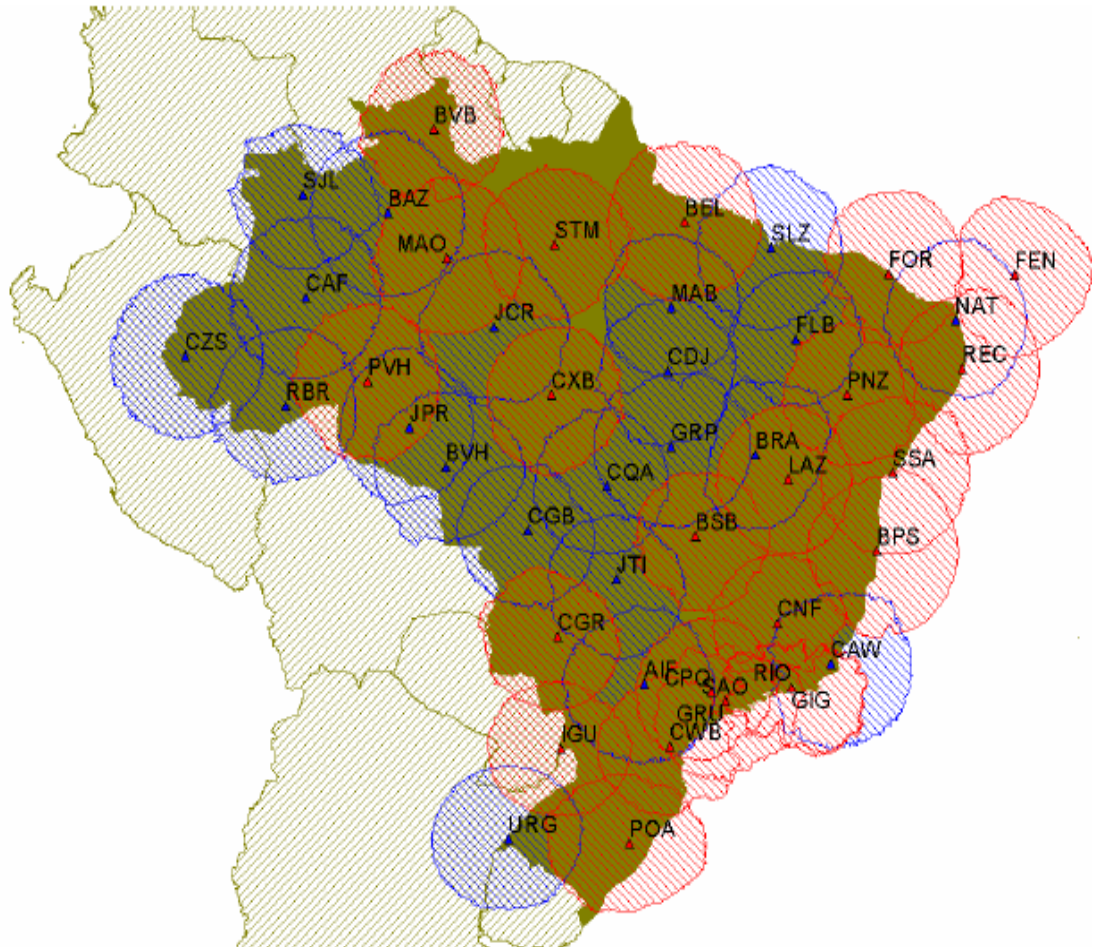


Figura 4: Cobertura VHF en Brasil para Enlace de Datos

Se destaca que en Brasil se ha decidido por la instalación de dos tipos de VHF *data-link*: analógico (VDL *Mode 0/A*) para la provisión del servicio para de las aplicaciones PRE-FANS (orientadas a carácter) y FANS 1A (CPDLC y ADS-C) en áreas remotas; VDL *Mode 2* para soportar el CPDLC en áreas de más movimientos de tránsito aéreo con el uso de ACARS y para la futura ATN.

En el área oceánica, Brasil ya tiene en uso el enlace de datos en el ACC-AO y las aeronaves pueden utilizar la tecnología haciendo el *log on* con dicho Centro de Control para el intercambio de mensajes CPDLC y ADS-C FANS (ACARS) con la utilización del SATCOM. En el Capítulo 3 (Enlace de Datos Aire-Tierra en el área Oceánica) se presenta informaciones sobre las características principales de las funcionalidades del ACC-AO.

Es importante mencionar que aunque sea posible la utilización de VDL *Mode 0/A* (VHF ACARS) para la transmisión de mensajes PRE FANS y FANS 1/A, la OACI no lo tiene como estándar. Cuando se consulta los documentos existentes, Anexo 10 – Vol 3 y Doc 9776 (*Manual on VHF Digital Link - VDL Mode 2*) no se hace referencia a la utilización del VDL *Mode 0/A*. Sin embargo, en el nuevo documento GOLD ya se admite la utilización del VHF ACARS.

En la elección de la plataforma de la subred aire-tierra es importante tomar en cuenta que los radios ACARS tienen una velocidad de transmisión de 2,4 kbit/s mientras los radios VDL *Mode 2* alcanzan la tasa de transmisión de 31,5 kbit/s, representando la posibilidad de transmitir más informaciones en un dado periodo de tiempo.

Con respecto a la aviónica, cuya estructura básica está mostrada en la Figura 3, los equipos actualmente desarrollados están en capacidad de intercambiar mensajes con la utilización del enlace analógico (ACARS) o de los radios VDL *Mode 2*. Los fabricantes de aviónica adicionaron la capacidad de transmisión de aplicaciones PRE FANS en los equipos VDL *Mode 2*. Con eso, si una aeronave está sobrevolando un área donde haya cobertura de VDL *Mode 2* y ACARS, hay la elección del VDL *Mode 2* en primer plano para la transmisión de las aplicaciones PRE FANS (ACARS), pero vuelve a transmitir por los radios ACARS (VDL *Mode 0/A*) fuera de las coberturas VDL *Mode 2*.

Hay en día la gran mayoría de la flota de aeronaves está equipada con equipos que proporcionan la utilización de los enlaces de datos ACARS, pero se prevé un considerable aumento en la adopción de los equipos VDL *Mode 2*.

Cuando se habla de ATN, se discute la implantación de módulos CPDLC en las aeronaves para la transmisión por medio de enrutadores ATN basados en el Modelo *Open System Interconnection* (OSI) de la *International Organization for Standardization* (ISO). En este sentido se utilizan los estándares ISO 8473 Connectionless Network Protocol que utiliza el protocolo de subred del VDL reflejado en el documento ISO 8208 *Switched Virtual Circuit* (SVC). Así, la aplicación ATN CPDLC solamente funciona mientras la aeronave posee una conexión VDL *Mode 2* con la estación terrestre ligada a un enrutador ATN de tierra.

Actualmente la utilización de CPDLC vía ATN está en uso en Europa donde la Implantación de Cielo Único (*Single European Sky*) requiere la adopción del CPDLC/ATN en todas las nuevas aeronaves en operación a partir de 2011. Con respecto a los antiguos aviones (en operación antes de 2011), hay la previsión de *retrofit* a partir de 2015 para todas las aeronaves de corto alcance en operación en el continente europeo. .

Es oportuno mencionar que Eurocontrol no que exige a las empresas aéreas de equipar las aeronaves con CPDLC/ATN desde que el certificado de aeronavegabilidad se obtuvo antes de 2014. Esto indica que podrán utilizar CPDLC/ACARS por todo su ciclo de vida en Europa.

Por otro lado, Eurocontrol reconoce que para operaciones de largo alcance, con operación en el área oceánica, se requiere CPDLC y ADS-C sobre la tecnología ACARS y todas las aeronaves sudamericanas que vuelen hacia Europa y estén certificadas hasta 2014 deberán, por lo menos, estar equipadas con enlace de datos ACARS.

Es importante observar la política de los Estados y ANSP para la implantación de enlace de datos, con la utilización de radios ACARS o VDL *Mode 2* ya que hay que tener en cuenta la importancia de dejar bien claro a los explotadores el cronograma de implantación de la arquitectura terrestre para que coincida con la instalación de los equipos en la flota.

En principio, la OACI no restringe la modalidad de implantación de la infraestructura de equipos de enlace de datos por VHF. Por ejemplo, en el Doc 9776 (*Manual on VHF Digital Link - VDL Mode 2*) se tiene varios escenarios posibles:

- a) VDL *Mode 2* y Red ATN operados por la Autoridad de Aviación Civil (CAA) solamente: las estaciones de VDL *Mode 2* de propiedad de la CAA están conectadas a enrutadores ATN también de propiedad de la CAA, proveyendo, por lo menos, servicios ATS;
- b) VDL *Mode 2* y Red ATN operados por el *Data Link Service Provider* (DSP) solamente: las estaciones de VDL *Mode 2* de propiedad del DSP están conectadas a enrutadores ATN también de propiedad del DSP, soportando servicios de interés de las empresas aéreas (AAC o AOC) y, si es requerido por la CAA, para servicios ATS. En ese caso, o enrutador ATN puede estar en otro Estado;
- c) VDL *Mode 2* y Red ATN operados por el DSP y la CAA: estaciones VDL *Mode 2* transmitiendo mensajes AAC, AOC para las empresas aéreas por medio de un enrutador del DSP (puede estar fuera del Estado), y estaciones VDL *Mode 2* (mensajes ATS para tráfico aéreo), ligados a un enrutador de la CAA (dentro del Estado);
- d) VDL *Mode 2* y Red ATN operados por el DSP y la CAA: estaciones VDL *Mode 2* de la CAA (aplicaciones ATS) y estaciones VDL *Mode 2* del DSP operando en una misma área de cobertura, cada uno con sus respectivos enrutadores ATN.

Nota: Si bien no está mencionado en el Doc 9776, el contenido para las cuatro opciones descriptas puede ser adaptado para en lugar de tenerse estaciones VDL *Mode 2* se tenga VDL ACARS. Por otro lado, para la parte de encaminamiento de mensajes en lugar de los Enrutadores ATN se tendrían Procesadores ACARS.

Asimismo, hay la posibilidad de considerar el modelo que está en curso en Brasil donde fue hecha una concesión de los servicios por medio de una licitación. Para el referido caso, se presentan los puntos principales del Proyecto Básico referente al proceso licitatorio en el **Apéndice F** de esta guía.

En ese caso, fue hecha una licitación para la exploración del Servicio Móvil Aeronáutico (SMA) en la categoría de enlace de datos y la vencedora del proceso fue la empresa SITA. La licitación fue hecha de acuerdo a una a La Ley de las Concesiones, que es un extenso documento que detalla las relaciones entre el Concedente y Concesionaria durante la vigencia contractual.

El sistema de concesión implantado en Brasil puede ser considerado una mezcla de las cuatro opciones arriba indicadas ya que la infraestructura de comunicaciones, englobando estaciones remotas, procesador ACARS, enrutador ATN está siendo implantado y operado por la Concesionaria bajo la supervisión del Concedente, que es el *Departamento de Controle do Espaço Aéreo* (DECEA).

2.4.2.2 Soluciones del subsistema de equipos VHF de tierra para enlace de datos

El primer aspecto que debe tomarse en cuenta en la implantación de enlace de datos es cuales son los servicios que serán transmitidos entre la aeronave y las dependencias ATC (ATSU) y usuarios privados. Esto es de vital importancia, pues determina la tecnología de los equipos de las estaciones remotas en VHF, que pueden ser analógicas (ACARS) o VDL *Mode 2*.

Es necesario el establecimiento de una política del Estado para la implantación de enlace de datos. Esto es un punto clave porque, como se ha referido anteriormente, la instalación de equipos para soportar solamente los mensajes FANS1/A demanda menos inversión; mientras la implantación de CPDLC por medio de ATN la inversión es más costosa no solamente para el ANSP como también para las empresas aéreas que tendrían que actualizar sus equipos de bordo.

En este sentido, si se decide por la instalación de equipos VHF *ground station* (VGS) es importante notarse que este soporta los dos tipos de radio, VDL *Mode 2* y ACARS, en un mismo bastidor. Con eso, se nota que el equipo es escalable y se puede empezar, por ejemplo, con la provisión de las aplicaciones ACARS y FANS 1/A y, si es necesario el despliegue de CPDLC en el área continental de considerable densidad de movimientos, la estación ya tiene una estructura básica instalada.

Normalmente una VGS se compone de dos partes principales: un computador terrestre (VGC) y un radio VHF digital (VDR) que es, en general, un transceptor. Además, es posible la instalación de varios equipos radios en una misma estación remota con algunos soportando VDL *Mode 2* y otros ACARS. En este caso, la cantidad de equipos instalada tiene relación directa con la disponibilidad global del sistema.

El transceptor VHF soporta la subcapa *Medium Access Control* (MAC) de la capa 2 (enlace) y la capa 1 (física). La computadora VGC se encarga de los protocolos de todas las capas que quedan arriba del MAC además de los protocolos VDL *Mode 2* y ACARS.

Normalmente se utilizan *racks* donde es posible la instalación de varios equipos radio VHF, que pueden operar simultáneamente en modo ACARS y VDL *Mode 2*, *Uninterruptable PowerSystem* (UPS), *switches* y/o enrutadores. Un ejemplo de un conjunto estándar es dado en la Figura 5.



Figura 5: Ejemplo de Rack VHF Data Link

2.4.2.3 Características principales del subsistema procesador central

El procesador *data-link* se considera como el corazón del sistema y maneja las funciones necesarias al encaminamiento de mensajes ACARS, de acuerdo con lo previsto en las especificaciones AEEC 618 (*Air/Ground Character-Oriented Protocol Specification*) y AEEC 620 (*“Data Link” Ground System and Interface Specification*).

El encaminamiento de mensajes debe soportar las aplicaciones PRE FANS y FANS 1/A, manteniendo la compatibilidad con las especificaciones AEEC 623 (*Character-Oriented Air Traffic Service (ATS) Applications*) e AEEC 622 (*ATS “Data Link” Applications Over ACARS Air-Ground Network*), con todas las funcionalidades.

Otro punto de vital importancia es garantizar los tiempos de respuesta, no respuesta, fallas de sistema, errores de gestión, y todas las demás situaciones que impidan la operación correcta. Además de eso, el sistema debe ser capaz de generar mensajes de notificación de todos los errores, permitiendo la recuperación de mensajes dentro de los tiempos requeridos a la seguridad operacional aplicable a los mensajes ATS.

También el sistema de procesamiento de mensajes debe convertir los mensajes de entrada tierra-tierra en mensajes de *uplink* apropiadamente formateados y conmutarlos para la mejor estación remota para el cierre del enlace con la aeronave.

Los servidores destinados a las aplicaciones ATS son normalmente aquellos que se refieren a las aplicaciones PRE FANS y que se juzga conveniente que estén instalados en el mismo sitio del procesador central. Los servidores ATS deben estar habilitados para las comunicaciones por medio de enlace de datos con cualquier aeronave que sobre vuele el espacio aéreo de un Estado. La descripción de los sistemas DCL, DATIS y DVOLMET se presenta en el **Capítulo 4** de esta guía.

Nota: Es muy importante que el procesador haga la conmutación para las direcciones de los servidores de las aplicaciones ATS del ANSP y AOC/AAC de las empresas aéreas. Específicamente con respecto a los mensajes ATS, si el sistema de enlace de datos no pertenece a un ANSP, como es el caso de la concesión de los servicios de enlace de datos de Brasil, es necesario que se tenga el *internetworking* entre los sistemas de enlaces de datos de los DSP.

2.4.2.4 **Características principales del subsistema enrutador ATN**

Como se ha mencionado, en Europa ya se tiene la adopción de la red ATN, que es llamada de ATN *Baseline 1*. La decisión de implantar el ATN es del Estado y ANSP, llevándose en cuenta los aspectos de demanda que justifiquen su implantación.

En Sudamérica ya han iniciado los planes para la adopción de la Red ATN para las comunicaciones aire-tierra. Algunas características son básicas para los enrutadores ATN y una de ellas es que se debe utilizar las mismas estaciones VDL *Mode 2* que posiblemente ya estén instaladas.

En la Tabla 3 de la Sección 2.5.3 se presenta la disponibilidad para las aplicaciones fin a fin, conforme descriptas en el Doc 9694 *Manual of Air Traffic Services "Data Link" Applications*. A este respecto, los enrutadores deberán tener una disponibilidad de, por los menos, 99,996% para que cumplan los requisitos previstos para las redes ATN.

También se debe tomar en cuenta que los enrutadores deben soportar el protocolo de red ATN CLNP, que es el protocolo de capa 3 del modelo OSI, pues todavía el soporte para la red ATN es basada en los estándares ISO.

2.4.2.5 **Características principales del subsistema de monitoreo**

El subsistema de monitoreo es el responsable por garantizar que todo el sistema de enlace de datos, incluyendo el procesador de mensajes, procesamiento de datos en las estaciones remotas (ACARS y VDL *Mode 2*), enlaces de redes terrestres, servidores de aplicaciones y equipos de conectividad de red estén operando satisfactoriamente.

2.4.3 **Future communication infrastructure (FCI)**

En los últimos años, la *Federal Aviation Administration* (FAA), en su programa *Next Generation Air Transportation System* (NextGen), y por el EUROCONTROL, con el *Single European Sky ATM Research* (SESAR), han establecido proyectos individuales y comunes para el desarrollo de lo que es conocido como el *Future Communications Infrastructure* (FCI), que cubre la evolución tecnológica con previsión de su aplicación a partir del Bloque 2 de ASBU para todas las fases del vuelo.

Entre las tareas en discusión, se destaca la posibilidad de transmitir las aplicaciones por medios concurrentes (*multilink*), de modo que tengan aumento de la disponibilidad y no sufran solución de continuidad. También es estudiada la adopción del *Quality of Service* (QoS), donde la red es configurada para dar, a cada aplicación, tratamientos diferentes, dependiendo de la criticidad y necesidad de transmisión en tiempo real.

Es interesante notar que la transmisión por *multilink* y el uso de QoS es muy común en el conjunto de protocolos IP (IPS). Sin embargo no son utilizados para fines ATM porque, a la fecha, la mayor parte de las aplicaciones fue desarrollada sobre el modelo de protocolos OSI, lo que deberá ser cambiado a corto y medio plazos.

En términos de tecnología de transmisión, lo que se prevé como posible sustituto del VDL Mode 2 para la implementación de enlace de datos aire-tierra, es el *L-Band Digital Aeronautical Communications System* (LDACS). Varias notas de estudio han sido presentadas en las últimas reuniones del Panel de Comunicaciones Aeronáuticas – *Aeronautical Communication Panel* (ACP) con respecto al asunto.

Las pruebas realizadas, a la fecha, presentan una buena expectativa en términos de tasa de transmisión. Sin embargo, la operación del LDACS se da en el mismo rango de frecuencia (950 a 1215 MHz) de una serie de aplicaciones aeronáuticas, tales como: radar secundario (SSR), Universal Access Transceiver (UAT) e Distance Measuring Equipment (DME). Por tal motivo, una batería grande de pruebas está en ejecución, considerándose los impactos entre el LDACS y los otros sistemas.

La situación actual es que está en proceso un proyecto del SESAR – P15.2.4 (Future Mobile Data Link System Definition) que contempla la elección entre dos candidatos para la futura tecnología de enlace de datos aire-tierra: LDACS1 y LDACS2. La Figura 7 da una muestra del alcance del proyecto donde se nota, claramente, que con el FCI ya no se tendrá el VDL Mode 2 como plataforma de soporte a las transmisiones aire-tierra.

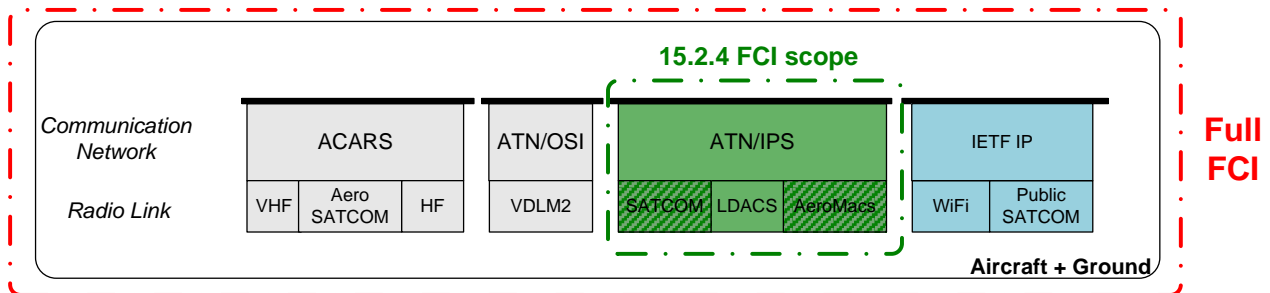


Figura 7: Alcance de las Actividades do P15.2.4

2.5 Subredes de comunicación tierra-tierra

2.5.1 Introducción

La tendencia del mercado de telecomunicaciones apunta para el uso de redes convergentes, concepto que es usado para las estructuras de telecomunicaciones dotadas de capacidad del tránsito de cualquier aplicación sean o no en tiempo real. Con esto, la misma topología puede ser utilizada para aplicaciones de audio, datos, video, etc, pudiendo o no ser interactivas.

Para que las redes convergentes funcionen satisfactoriamente, cada aplicación debe ser tratada de forma única, de acuerdo a las características intrínsecas. Por ejemplo, telefonía y videoconferencia son aplicaciones en tiempo real y, así, no soportan atrasos considerables, pero no necesitan de garantía de integridad de datos. Al revés, aplicaciones de datos críticos pueden tolerar un atraso pequeño en la transmisión, pero no admiten pérdida de información, exigiendo garantía en la entrega en el destino.

Por otro lado, servicios de almacenamiento o de correo electrónico permiten mayores atrasos. Para resolver esas diferencias es aplicado el concepto de Calidad de Servicio (QoS) en redes estadísticas, lo que permite la priorización de cada aplicación.

Actualmente, las aplicaciones de radar y VHF pasan por canales determinísticos contratados junto a CSP. Eso permite un control rígido de la calidad del servicio prestado, garantía de seguridad y de inviolabilidad de las comunicaciones con respecto a accesos por otros clientes del proveedor, pues no hay compartimiento de recursos de canalización.

Sin embargo, la estructura es rígida, causando grandes pérdidas de recursos de telecomunicaciones. Al revés, las redes estadísticas, basadas en *Internet Protocol* (IP), permiten una disponibilidad de recursos de acuerdo con la demanda de las aplicaciones y de cada cliente, reduciendo los costos de implantación y de mantenimientos.

Para la implantación de la infraestructura terrestre para soporte al enlace de datos aire-tierra es imprescindible que la subred terrestre garantice la disponibilidad requerida en las provisiones de la OACI.

Para las redes basadas en IP, la OACI desarrolló, por medio del Panel de Comunicaciones Aeronáuticas (ACP), el Doc OACI 9896 – Manual para la Red de Telecomunicaciones Aeronáuticas (ATN) con el uso de los Protocolos y Estándares IPS. El documento trata de las cuestiones técnicas, de seguridad, de calidad de servicio (QoS) y de las aplicaciones. Debe ser tomado en cuenta que la mayor parte de las provisiones de la OACI fueron preparadas tomando por base el Modelo OSI y que con el pasar del tiempo la tendencia es que sean remplazadas por el Modelo IP.

En términos de la Región SAM, se desarrolló una Guía de Orientación para la Implementación de Redes Nacionales Digitales en Protocolo IP, que presenta consideraciones a los Estados SAM en la hora de implantar la red, aspectos técnicos relacionados a los equipos, sistemas, monitoreo y aplicaciones.

Asimismo fue preparada una Política de Enrutamiento para la Región SAM que refleja el contenido del Doc 9896 sobre las técnicas de enrutamiento por dominio inter intra-regionales. Las referidas técnicas deberán ser incorporadas a la Red Digital Sudamericana (REDDIG) después que la nueva infraestructura esté implantada (REDDIG II).

Teniéndose en cuenta los importantes y complejos aspectos que involucran la seguridad de las redes IP, fue preparada una Guía de Orientación de Seguridad para la Implantación de Redes IP con las buenas prácticas que pudieran ser consideradas por los Estados en la hora de la implantación de sus redes.

En la Sección 2.5.2 se discutirá una arquitectura compatible con las demandas de disponibilidad, tomándose por base la infraestructura que será implantada para la modernización de la Red Digital Sudamericana (REDDIG) y que también es adoptada por varios Estados Sudamericanos. En la Sección 2.5.3 se discutirá la disponibilidad de dicha topología.

2.5.2 Arquitectura recomendable para la subred terrestre

2.5.2.1 General

Para que se tenga la disponibilidad y confiabilidad requerida para la subred terrestre en apoyo a las comunicaciones aire-tierra, se recomienda la implantación de dos *backbones*: uno satelital y otro MPLS terrestre, conforme al esquema de la Figura 8.

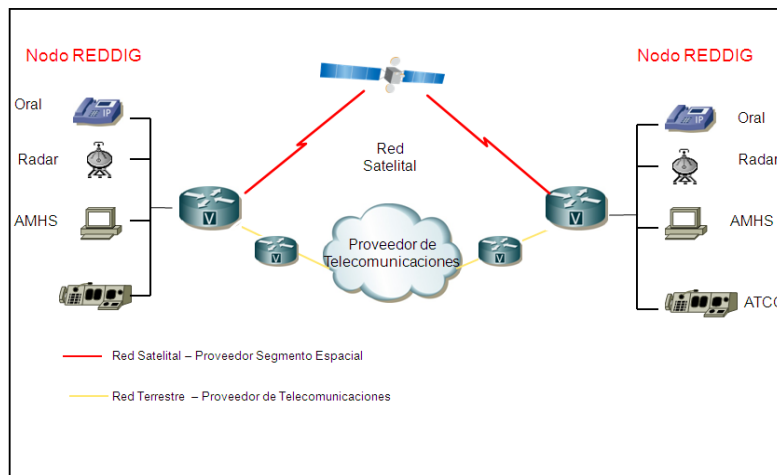


Figura 8: Topología Básica de la Subred Terrestre

2.5.2.2 Estructura satelital

Las comunicaciones por satélite son la solución ideal de interconexión de sitios que están muy alejados geográficamente. A la fecha el mercado ofrece muchas soluciones tecnológicas para esas comunicaciones, en lo que respecta a equipos desarrollados por diferentes fabricantes para diferentes utilidades.

Es importante enfatizar que, en términos de transmisiones satelitales, el gran problema son los costos recurrentes mensuales (OPEX). Así, son importantes las cuestiones relacionadas a las codificaciones y compresiones, la modulación empleada y la técnica de acceso al medio, tales como: acceso múltiple por división de tiempo (TDMA), frecuencia (FDMA) o Código (CDMA).

Otro punto que tiene considerable importancia es la modulación empleada. En las técnicas modernas de modulación para transmisión satelital, se utiliza actualmente el 8- PSK, que transmite 3 bits por cada símbolo

Como el canal de transmisión puede tergiversar y causar errores a la información, es aplicado un Código Corrector de Errores. Las técnicas modernas de correctores de errores evolucionaron y sistemas modernos emplean el *Turbo-Coding* 7/8, donde un bit de redundancia es puesto para cada siete bits de información útil.

Con referencia a la tecnología de acceso al medio que puede ser empleada, se sugiere que no debiera restringirse a una tecnología específica de acceso al medio, modulación, código corrector de errores, etc.; o sea el foco debe de estar en los servicios, en vez de elegirse una plataforma específica.

Es importante mencionar que la topología satelital posibilita una serie de posibilidades de implantación. Por ejemplo, el ANSP puede adquirir los equipos y rentar segmento espacial, puede contratar los servicios que contemplen la instalación de los equipos y el ofrecimiento de segmento espacial, entre otros formatos.

2.5.2.3 Estructura terrestre (IP/MPLS)

Actualmente, cuando se hace la contratación de redes terrestres los CSP ofrecen, casi que invariablemente, la tecnología basada en IP/MPLS.

El MPLS es una tecnología de encaminamiento de paquetes basada en etiquetas (*labels*) que funciona, en su esencia, con la adición de etiquetas por determinados encaminadores (enrutadores) de la red. El MPLS es indiferente a los tipos de datos transmitidos, que pueden ser tráfico IP (Internet Protocol) o de otros tipos de protocolos a la entrada del backbone y, a partir de ese punto, todo el encaminamiento pasa a ser hecho en base a las referidas etiquetas agregadas.

Comparativamente al enrutamiento IP, el MPLS resulta más eficiente una vez que dispensa la consulta de las tablas de enrutamiento en todos los activos de red. Además de eso, presenta la flexibilidad de permitir la transmisión de mensajes de forma independiente de la pila de protocolos utilizada en las capas superiores.

El MPLS permite la creación de *Virtual Private Networks* (VPN), garantizando un aislamiento completo del tráfico con la creación de tablas de etiquetas exclusivas de cada VPN. También es posible realizar *Quality of Service* (QoS) con la priorización de aplicaciones críticas, dando un tratamiento diferenciado para el tráfico entre los diferentes puntos de la VPN. El QoS crea las condiciones necesarias para el mejor uso de los recursos de red, lo que permite también el tránsito de aplicaciones de voz e video, y otras aplicaciones continuas, en tiempo real.

La Figura 9 presenta la forma de transmisión de paquetes en una red IP tradicional. Conforme puede ser notado en la misma, en todos los encaminadores se realiza una consulta a la tabla de enrutamiento, lo que consume recursos de procesamiento y ocasiona un mayor retraso en la transmisión de la información. Esto se debe al hecho de que en cada enrutador se quita los encabezados hasta el nivel 3 de la capa OSI de la ISO.

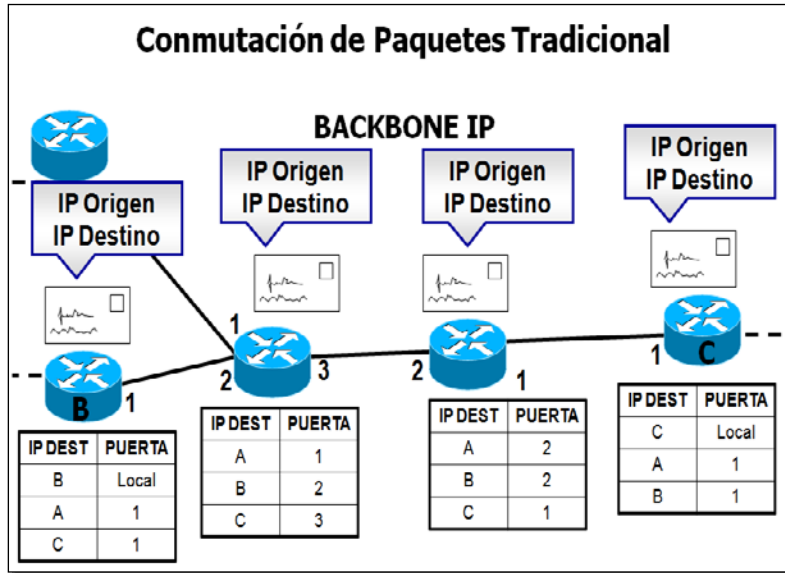


Figura 9 Conmutación IP

A través de la Figura 10, puede notarse que el enrutamiento de paquetes con el uso del MPLS se da por medio de una tabla de etiquetas, por lo que resulta innecesario quitar los encabezados de los paquetes hasta el nivel 3 OSI. El MPLS opera en una capa intermedia en relación a las definiciones tradicionales de capa 2 (enlace) y la capa 3 (red), por lo que se tornó recurrente llamarle protocolo de capa 2,5.

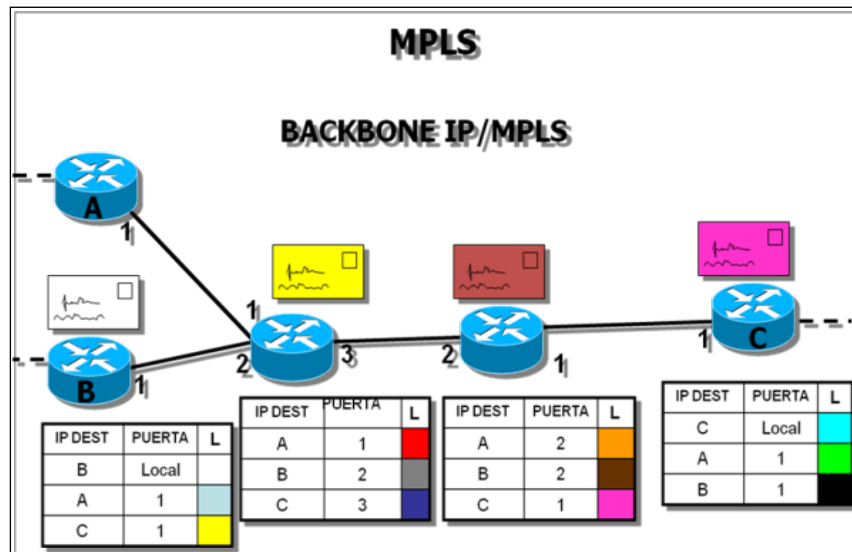


Figura 10: Conmutación MPLS

Para lograr pleno éxito en los contratos MPLS, es necesario establecer características en los *Service Level Agreements* (SLA) que garanticen la creación de VPN con el uso del MPLS, de acuerdo a la RFC 2547 y RFC 3031, y posibilitar la configuración de QoS sobre MPLS/VPN, de acuerdo al dispuesto en la RFC 3270 y RFC 2938.

De acuerdo con las prioridades y niveles de SLA requeridos, los diferentes tipos de paquetes que traficarán por la red serán clasificados en, por lo menos, cinco tipos de servicio, siguiendo los patrones de las RFC 2474 y 2475 (DiffServ), complementados por la RFC 2597 (*Assured Forwarding* PHB) y por la RFC 2598 (*Expedited Forwarding*).

Un ejemplo de clasificación que puede ser seguida para las configuraciones de QoS la que sigue:

- a) *Tiempo real*: Aplicaciones sensibles al retardo (*delay*) y variaciones de retardo de la red (*jitter*), que exigen priorización de paquetes y reserva de banda;
- b) *Misión Crítica*: Aplicaciones interactivas críticas para el tráfico de informaciones operacionales críticas, que exigen entrega garantizada y tratamiento prioritario;
- c) *Gerenciamiento*: Aplicaciones de gerencia de red, utilizando protocolos ICMP, SNMP, Telnet, etc.;
- d) *No Crítico*: Aplicaciones con mensajes de tamaño muy variado y no imprescindibles para la atención inmediata a los usuarios. Aunque se trate de contenido importante, son aplicaciones que pueden esperar por disponibilidad de recursos de la red; y
- e) *Estándares*: Todo el tráfico no explícitamente atribuido a las clases definidas arriba, serán clasificadas de estándar, o, como también es conocido, del tipo *best-effort*. Tal tipo de tráfico puede ser transmitido si hay recursos disponibles en la red, pero no puede tener impacto negativo en las otras clases.

2.5.3 Disponibilidad de las subredes de comunicaciones

La Figura 11 representa los principales vínculos entre una estación de comunicación VDL Mode 2 o SATCOM a las dependencias ATC. En este sentido serán hechas consideraciones de disponibilidad para las subredes que normalmente son contratadas por los ANSP para el proveimiento de los servicios.

GUIA DE ENLACE DE DATOS AIRE-TIERRA SAM

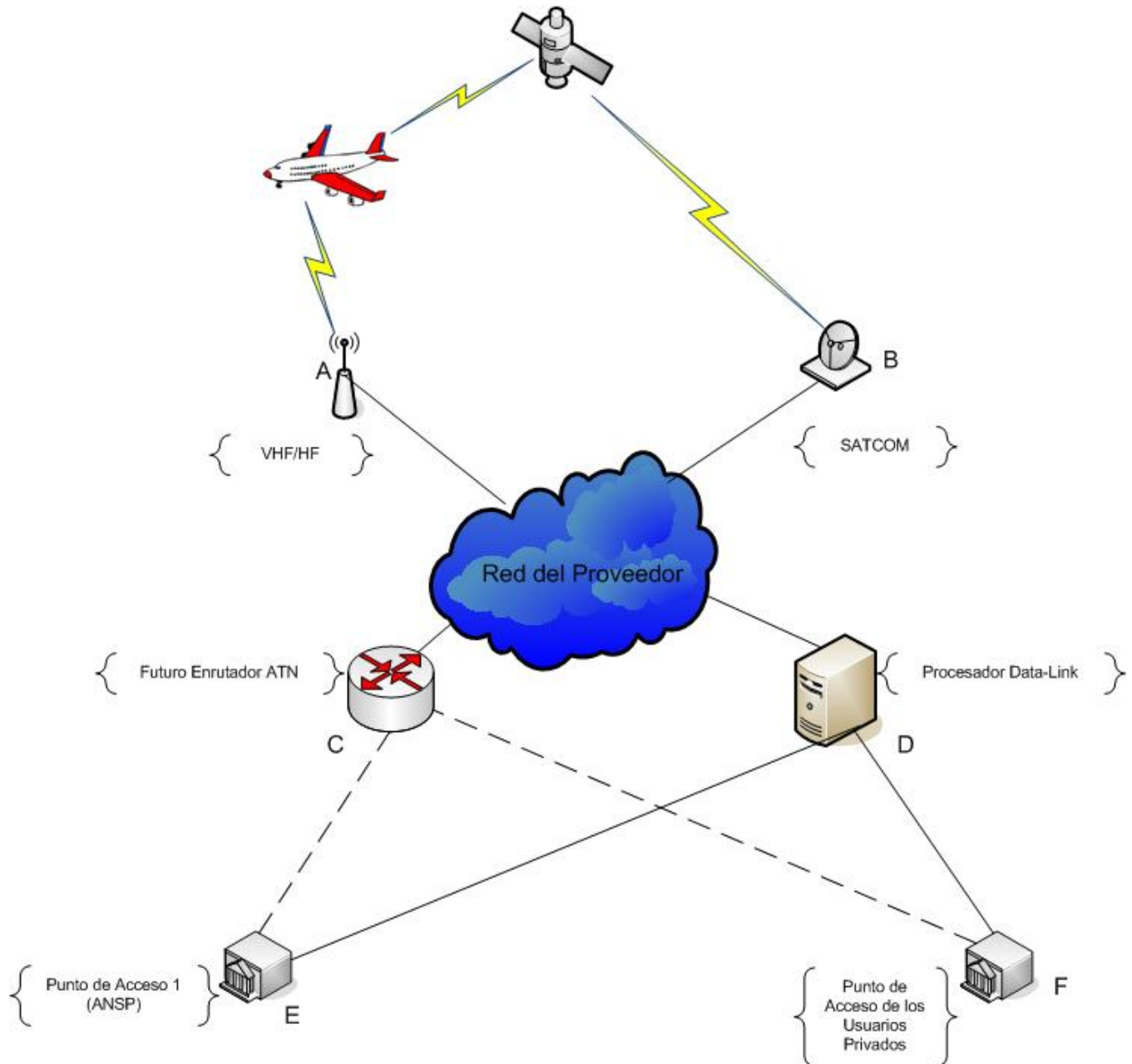


Figura 11 Infraestructura de básica de telecomunicaciones tierra-aire

Hoy en día se utiliza, alrededor del globo terrestre, el FANS 1/A para la implantación de enlace de datos, admitiéndose la utilización de equipos fin a fin con la tecnología ACARS para las aplicaciones descritas en los documentos FANS 1/A *Operational Manual* (FOM), GOLD, AEEC 618, 620, 622 y 623, entre otros.

Específicamente en los criterios de desempeño admitidos para el uso de FANS 1/A hay una tabla con los requisitos principales como está transcrito a seguir en su original en inglés.

GUIA DE ENLACE DE DATOS AIRE-TIERRA SAM

Criteria	Definition	Values
Performances	End-to-end round trip time for uplinks per delivery media (VHF, SATCOM, or HF DL). The timing is measured from sending of the uplink until reception of the MAS.	Round trip time of 2 minutes, 95% of the messages. Round trip time of 6 minutes, 99% of the messages.
	End-to-end one way time for downlinks per delivery media (VHF, SATCOM, or HF DL). The timing is measured by comparing the message sending time stamp and message receipt time stamp.	One way time of 1 minute, 95% of the messages. One way time of 3 minutes, 99% of the messages
	Uplink messages only: Undelivered messages will be determined by: <ul style="list-style-type: none"> • Message assurance failure is received. After trying both VHF and SATCOM. Depending on reason code received, the message might, in fact, have made it to the aircraft. • No message assurance or flight crew response is received by ATSU after 900 seconds 	Less than 1% of all attempted messages undelivered
Availability	The ability of the network data link service to perform a required function under given conditions at a given time: The maximum allowed time of continuous unavailability or downtime should be declared: it can be expressed in MTTR (Mean Time To Repair) *	99.9% TBD
Reliability	The ability of a data link application/system to perform a required function under given conditions for a given time interval: it can be expressed in MTBF (Mean Time Between Failure) *	TBD
Integrity	The probability of an undetected failure, event or occurrence within a given time interval.	10^{-6} /hour

* Availability = $MTBF \times 100 / (MTBF + MTTR)$

Tabla 1: Criterios de Desempeño para el FANS 1/A

Un análisis simple de la Tabla 1 conduce a la conclusión de que es admitida la disponibilidad de 99,9% para que se complete cualquier tipo de servicio de enlace de datos. Por otro lado, se admite un tiempo de retraso de 1 minuto para 95% de los mensajes intercambiados y de 3 minutos para 99% del total de dichos mensajes, independientemente si el medio de comunicación es SATCOM, VHF o HF DL.

GUIA DE ENLACE DE DATOS AIRE-TIERRA SAM

<i>RCP type</i>	<i>Transaction time (sec)</i>	<i>Continuity (probability/flight hour)</i>	<i>Availability (probability/flight hour)</i>	<i>Integrity (acceptable rate/flight hour)</i>
RCP 10	10	0.999	0.99998	10 ⁻⁵
RCP 60	60	0.999	0.9999	10 ⁻⁵
RCP 120	120	0.999	0.9999	10 ⁻⁵
RCP 240	240	0.999	0.999 0.9999 (efficiency) (See Note 3)	10 ⁻⁵
RCP 400	400	0.999	0.999	10 ⁻⁵

Tabla 2: Parámetros de Desempeño por Tipo de RCP

Como se mencionó anteriormente, el Doc 9869 *Manual on Required Communication Performance* asocia las aplicaciones a tiempos de transacción de mensajes, disponibilidad, continuidad y integridad con fines de apuntar cuales son las separaciones longitudinales y laterales ideales para cada espacio aéreo. En ese sentido, aparece la Tabla 2 referente a tipos de RCP para el suceso de la transmisión de mensajes.

Comparando los requisitos de las Tablas 1 y 2, se llega a la conclusión de que en términos de tiempo de transacción y de disponibilidad la utilización de FANS 1/A es posible para los requisitos operacionales de RCP 240 y RCP 400. Sin embargo, la nota 3 de la Tabla 2 afirma que los valores de disponibilidad son basados en la evaluación de seguridad, llevándose en consideración el ambiente, como los procedimientos de mitigación para fallas de comunicación y las posibles acciones de contingencias. Menciona, también, que para el RCP 240 si puede agregar el parámetro de disponibilidad de 99,99%, basado en efectos operacionales de pérdidas frecuentes de servicio y que los dos valores deberán ser evaluados por el Estado que implante el enlace de datos.

Es por esa razón que el documento GOLD trata de la utilización del RCP 240 y 400, en conjunto con los requisitos de desempeño de vigilancia (RSP 180 y RSP 400), ya que lidia, principalmente con operaciones en las áreas remotas y oceánicas, donde es perfectamente posible la adopción del FANS 1/A para los enlaces de datos para las separaciones longitudinales de 50 NM y 30 NM, y separaciones laterales de 30 NM. Para reforzar esta asertiva, describe que para operaciones en el área continental donde se requiera requisitos operacionales más restrictos, como el RCP 150, no debería contar con la utilización de equipos VDL Mode 0/A.

Sin embargo, cuando se trata de disponibilidad de aplicaciones es importante tener en cuenta lo que está descripto en la Tabla I3A1 del Doc 9694 *Manual of Air Traffic Services "Data Link" Applications*, que está reproducida a seguir en la Tabla 3:

GUIA DE ENLACE DE DATOS AIRE-TIERRA SAM

<i>Application</i>	<i>Availability (%)</i>	<i>Integrity</i>	<i>Reliability (%)</i>	<i>Continuity (%)</i>
DLIC	99.9	10^{-6}	99.9	99.9
ADS	99.996	10^{-7}	99.996	99.996
CPDLC	99.99	10^{-7}	99.99	99.99
FIS	99.9	10^{-6}	99.9	99.9
AIDC	99.996	10^{-7}	99.9	99.9
ADS-B	99.996	10^{-7}	99.996	99.996

Tabla 3: Disponibilidad de Aplicaciones de Enlace de Datos

En resumen, comparándose las Tablas 3 con la Tabla 1, se llega fácilmente a la conclusión que no se puede utilizar el FANS 1/A para la transmisión de la mayor parte de las aplicaciones en el ambiente ATN y que, para tal, se deberá contar con la adopción de enrutadores ATN y radios VDL *Mode 2*

Es importante notar en la segunda columna la disponibilidad de los servicios fin a fin. Eso quiere decir que las subredes de telecomunicaciones que sean utilizadas para la transmisión de las informaciones deben tener una disponibilidad mayor, pues como se ha descrito en el **Apéndice E**, elementos en serie disminuyen la disponibilidad global.

De esta forma, se identifican los siguientes elementos en la cadena fin a fin entre una aeronave y un ATSU:

- a) Disponibilidad de los equipos de bordo: *Flight Management System* (FMS), impresoras, etc.;
- b) Subred aire-tierra (SATCOM o VHF);
- c) Redes terrestres;
- d) Procesador central o enrutador ATN (cuando instalado); y
- e) Disponibilidad de los equipos del ATSU.

Para garantizar una disponibilidad más alta posible es importante que las subredes terrestres cuenten con redundancia de medios de transmisión. Así, con respecto a las subredes terrestres, la Figura 11 representa los elementos principales entre los nodos A (VHF) B (SATCOM) y aquellos que se tienen después de la transmisión de las aplicaciones por las subredes terrestres (C - Enrutador ATN y D - Procesador Data-Link).

Para el medio de transmisión aire-tierra, lo que se hace es instalar equipos redundantes en la aeronave y estaciones terrenas, lo que puede hacer con que la disponibilidad alcance altísimos niveles. Cuando se usa el SATCOM, la disponibilidad es aquella descrita en los contratos con el proveedor de servicios actuales (SITA y ARINC) que, por su vez, subcontratan segmento espacial de los proveedores que existen en el mercado que son, normalmente, INMARSAT y IRIDIUM. El **Apéndice G** presenta algunas características básicas sobre el servicio SATCOM fornecido por los principales Proveedores de Segmento Espacial.

Con respecto a los equipos de VHF, es necesario tomar en cuenta además de la disponibilidad de los radios, las condiciones de infraestructura de alimentación eléctrica, del sistema irradiante y de la posibilidad del VHF quedar fuera de servicio por cuestiones de interferencia en la frecuencia.

La configuración presentada en la Figura 11 puede ser comprendida como aquella que sería encontrada en una región continental, ya que la presencia de equipos VHF implica, necesariamente, que existan estaciones remotas instaladas por el territorio de un Estado. Lógicamente, para las comunicaciones en el área oceánica solamente hay la adopción de la tecnología de transmisión por satélite.

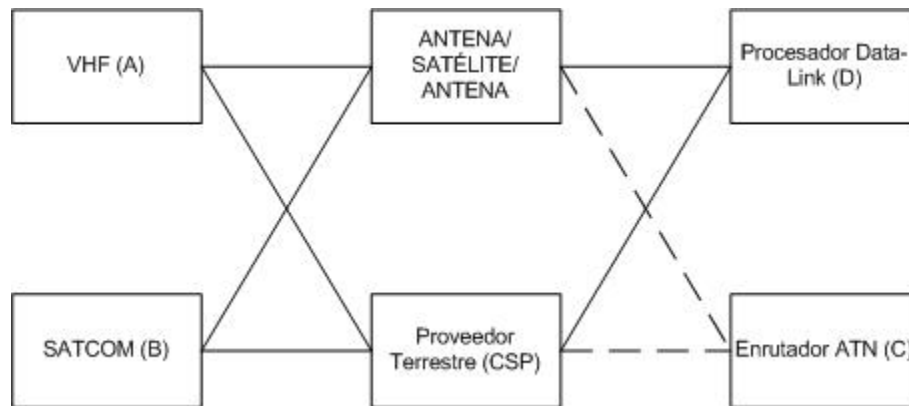


Figura 11: Diagrama de las Redes de Comunicaciones

Tomándose en cuenta que la disponibilidad de las redes terrestres contratadas junto a CSP es de, normalmente, 99,5% y que la disponibilidad de los sistemas de comunicaciones por satélite alcanzan, fácilmente, los 99,5% se llega a la conclusión de que la resultante de los medios en paralelo es de 99,998%, lo que es compatible con los valores de la Tabla 1 con otros elementos que deberán ser colocados en serie como los VHF o SATCOM, impresoras, etc.

Con esto, se concluye que es importante que los ANSP proyecten sistemas de comunicaciones de la subred terrestre de tal modo que garanticen una disponibilidad confortable a efecto de que cuando se consideren los demás sistemas en serie (aviónica, equipos del ATSU, etc.) la disponibilidad resultante sea compatible con los valores presentados en las tablas de esta sección para las características operacionales elegida por el ANSP en determinada *Flight Information Region* (FIR).

3. ENLACE DE DATOS AIRE-TIERRA EN EL AREA OCEANICA

3.1 Enlace de datos en el área oceánica en líneas generales

Como ya mencionado, el enlace de datos proporciona mejoría en las comunicaciones, vigilancia y desempeño de los sistemas de navegación. Por esto, es posible, con el uso de FANS 1/A en las aeronaves y ATSU, alcanzar requerimientos para el RCP 240 y RSP 180. En términos prácticos, se puede garantizar la separación lateral de 30 NM y longitudinal de 50 NM o 30 NM.

Para tal fin, son habilitadas las principales aplicaciones aire-tierra que son el CPDLC y ADS-C, que son aplicaciones orientadas a *bit*. Las próximas secciones tratarán de cómo se puede implantar sistemas para atender a las aplicaciones aire-tierra en área oceánica, tomando como base la exitosa experiencia de Brasil, que podría servir de punto de partida para Estados que pretendan implantar enlaces de datos.

3.2 Enlace de datos en el área oceánica – ACC-AO Brasil)

3.2.1 Generalidades

Antes de iniciar la descripción de las funcionalidades existentes en el ACC- Atlántico (AO) de Brasil, se presenta, en la Figura 12, la conformación de las FIR de Brasil.



Figura 12: Regiones de Información de Vuelo de Brasil

Como se puede notar por la Figura 12, el área de gestión de tránsito aéreo por parte del ANSP de Brasil - *Departamento de Controle do Espaço Aéreo* (DECEA) es muy grande, totalizando, aproximadamente, 22.000.000 km². Específicamente, en relación al área oceánica, correspondiendo al ACC-AO, se tiene un área de actuación de más de 11.000.000 km².

3.2.2 Situación anterior

En lo que concierne al Servicio Móvil Aeronáutico (SMA), las comunicaciones bilaterales entre las dependencias ATS y las aeronaves que sobrevuelan la porción oceánica de Brasil eron realizadas exclusivamente por voz con equipos *high frequency* (HF).

Como se sabe, las comunicaciones en HF poseen la característica de largo alcance y, por lo tanto, permiten coberturas en áreas muy extensas con la implementación de una única estación terrestre. Sin embargo, la comunicación en HF es afectada por eventos producidos por el sol, por el campo magnético de la tierra e por cambios en las condiciones de la atmosfera que afectan la ionósfera, medio de propagación de la comunicación en HF y, consecuentemente, su radio propagación. Entre estos efectos, se puede citar:

- a) Las tempestades ionosféricas, más significativas en términos de duración;
- b) Los disturbios repentinos de la ionósfera – *Sudden Ionospheric Disturbances* (SID), que poseen corta duración;
- c) Enmudecimientos rápidos – *Short Wave Fade* (SWF), causados por la emisión de radios X, provenientes del sol;
- d) Vientos y ondas que se manifiestan en la atmósfera neutra y afectan la distribución de la ionización y, por lo tanto, las propiedades refractivas de la ionósfera;
- e) Ondas gravitacionales acústicas – *Acoustic Gravity Waves* (AGW) con varias escalas asociadas a los periodos de transición del día para la noche y tempestades.

Las frecuencias HF disponibles para el control de tráfico aéreo son definidas mundialmente a través de la OACI y componen un pequeño grupo para uso regional. De ese modo, existen algunas limitaciones en la selección de canales del SMA, lo que es compensado por la utilización de antenas de alta ganancia y potencia elevada, recursos que no garantizan al sistema una disponibilidad adecuada, ocasionando eventuales periodos con comunicación precaria.

Por otro lado, en relación a los aspectos de navegación aérea y vigilancia, las limitaciones inherentes al área oceánica torna inviables la implantación de radio ayudas y equipamientos radar en la superficie. Por lo tanto, debido a las consideraciones de seguridad de las operaciones, mayores separaciones entre aeronaves eran empleadas, disminuyendo la capacidad del espacio aéreo e impidiendo el atendimento de las demandas en algunas porciones de la región oceánica.

3.2.3 Situación actual

La creación del ACC Atlántico, fue resultante de la unificación del espacio aéreo oceánico bajo la jurisdicción de Brasil en una única Región de Información de Vuelo (FIR Atlántico) con significativos impactos en el ATM brasileño. De esa manera, se inició la transición hacia el nuevo concepto del espacio aéreo continuo (*seamless airspace*).

La activación del ACC-AO, por lo tanto, privilegió la aplicación de funcionalidades del sistema CNS/ATM, a través de las tecnologías de transmisión por satélite y comunicaciones digitales que propiciaron la implantación de la Separación Vertical Mínima Reducida (RVSM), la Vigilancia Dependiente Automática por Contrato (ADS-C) y la Comunicación Controlador Piloto por Enlace de Datos (CPDLC).

Como se sabe, en el área oceánica la comunicación de datos es realizada por medio de SATCOM. A este respecto, las empresas aéreas firman contrato con el proveedor de servicios (SITA o ARINC) los cuales poseen contratos con el proveedor de segmento espacial INMARSAT o IRIDIUM. El **Apéndice G** dará más detalles a respecto del funcionamiento del SATCOM. La Figura 13 describe el camino de los mensajes de enlace de datos entre en ACC-AO e las aeronaves.

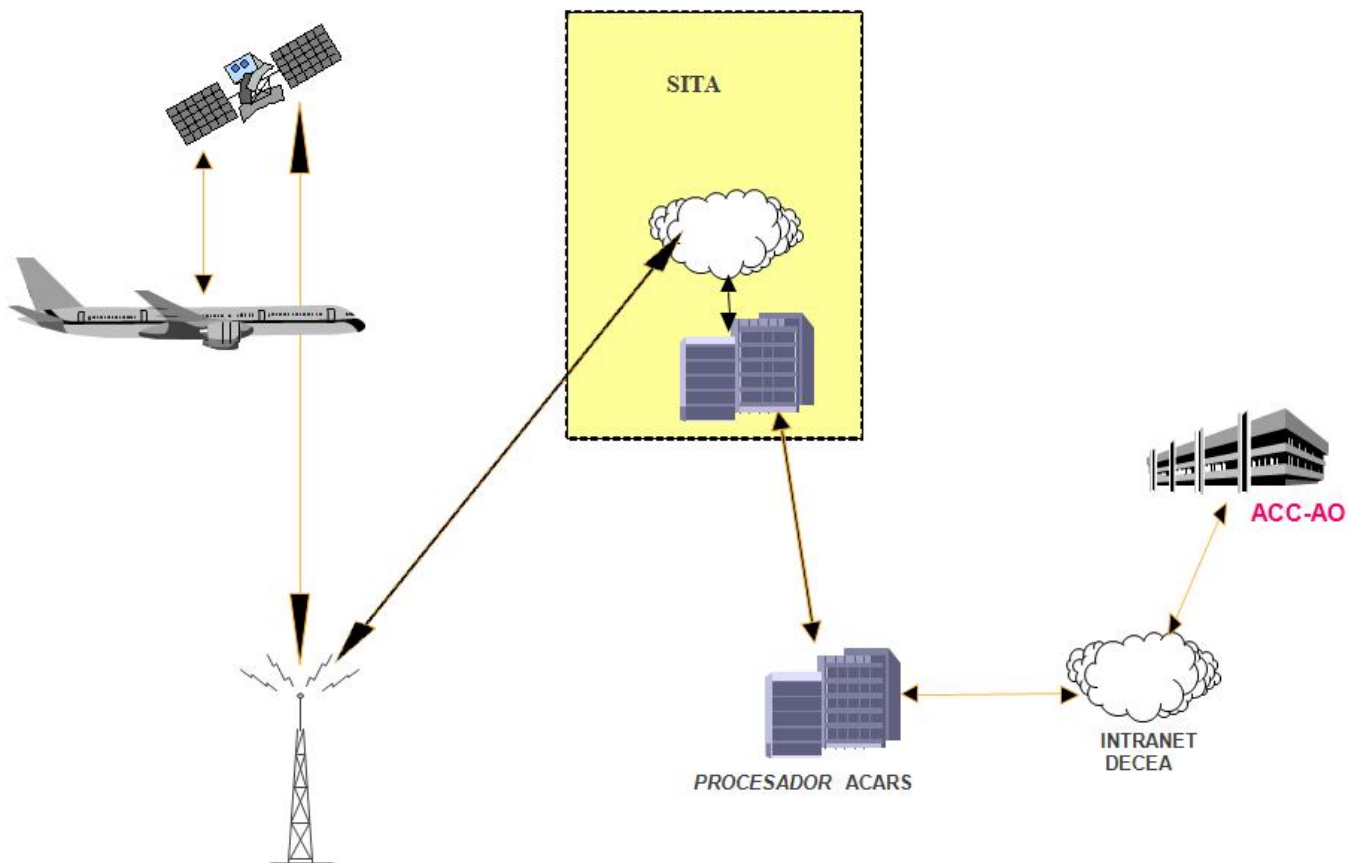


Figura 13: Encaminamiento de Mensajes de Enlace de Datos Tierra-Aire en el ACC-AO

Con respecto a las fechas de activación, se destaca que el ADS-C fue implantado primeramente, en el día 23/10/2008, y un beneficio directo fue que las aeronaves equipadas y que hicieron el *log on* con el ACC-AO no tuvieron más que reportar las posiciones en los fijos obligatorios hasta entonces. El CPDLC entró en operación el 30/07/2009 en conjunto con el ADS-C.

GUIA DE ENLACE DE DATOS AIRE-TIERRA SAM

La utilización de nuevos medios CNS, en conjunto con la evolución de la gestión ATM, permitió que los usuarios y, en especial, las empresas aéreas tuvieran condiciones de utilizar rutas más económicas y flexibles, lo que compensa, con ventajas, las inversiones en aviónica, además de reducir la carga de trabajo de pilotos y controladores. Por otro lado, las aeronaves no equipadas continuaron a efectuar las comunicaciones por medio del HF.

La Figura 14 ilustra la forma de operación de la flota que utiliza los servicios del ACC-AO después de la implantación de las aplicaciones por enlace de datos, en que se nota que las aeronaves que utilizan enlace de datos pueden volar en niveles más altos en relación aquellas que continúan utilizando solamente el HF para las comunicaciones con el ACC-AO..

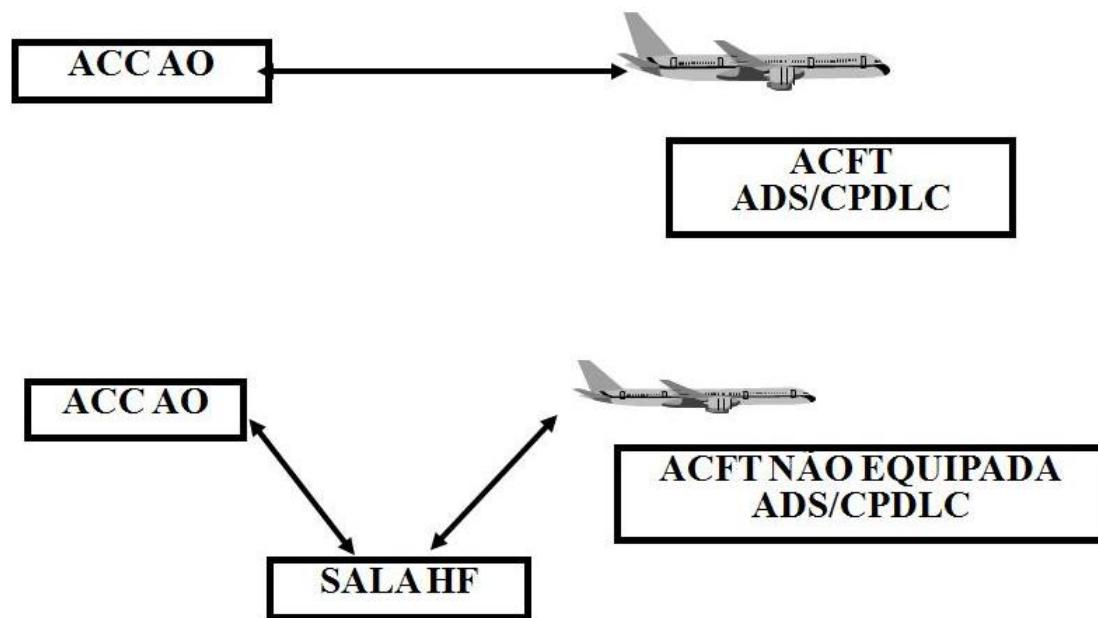


Figura 14: Modelo Operacional del ACC-AO con Enlace de Datos

La adopción de las funcionalidades de CPDLC y ADS-C permitieron el atendimento de una serie de objetivos del ATM en el espacio aéreo oceánico, tales como:

- Aumento de la capacidad del espacio aéreo, a través de la reducción de los mínimos de separación entre aeronaves, en todas las dimensiones (vertical, lateral y longitudinal);
- Aumento de la capacidad de las dependencias ATC;
- Vuelos en perfiles óptimos de performance;
- Adopción de un sistema de rutas aleatorias y directas; y
- Atendimiento de la demanda de tráfico aéreo, principalmente en el corredor EUR/SAM.

Por otro lado, la aplicación de las referidas aplicaciones propició la transición de las técnicas de control de tránsito aéreo basadas en la comunicación oral entre piloto y controlador para técnicas que aplican enlace de datos, considerándose los factores humanos involucrados que recibieron considerables entrenamientos para el desempeño de sus funciones con las nuevas tecnologías.

Por supuesto que las comunicaciones en HF merecieron atención especial, pues no solamente son utilizados como medio alternativo para las aeronaves equipadas con enlace de datos, pero también es la forma de comunicación principal para aquellas no equipadas. En términos más técnicos, el ACC-AO recibió equipos HF más modernos y con mayor potencia, completando el conjunto anterior instalado. De hecho el sistema HF actual es capaz de alcanzar una disponibilidad global de 98%, considerándose, en los cálculos, los puntos de fijos para control de la FIR Atlántico.

En términos operacionales, el ACC-AO está dotado de consolas que poseen sistemas de visualización y tratamiento de planes de vuelo, bien como la capacidad de realizar el acompañamiento de la progresión de vuelos, realizar la predicción de conflictos en trayectorias fijas y aleatorias, tratamiento automatizado de mensajes FPL y capacidad de emitir alertas en situaciones de conflicto de corto y medio plazos, además de ser capaz de cambiar mensajes automáticamente con los centros continentales limítrofes de Brasil.

La visualización de los datos ADS-C está disponible en todas las consolas de operación, integrada con las informaciones de los radares de vigilancia. En los casos de ausencia del ADS-C y radar, la visualización es derivada de extrapolaciones (pista navegada). El sistema de tratamiento de datos utilizado y la prestación de los servicios del ACC Atlántico posee un alto grado de confiabilidad, disponibilidad e integridad. La posibilidad de fallas o degradación significativas, que puedan causar interrupción parcial o completa del sistema, están inseridas dentro de los parámetros de tolerancia aceptos internacionalmente.

El CPDLC posee un conjunto de elementos de mensajes de autorizaciones/informaciones/ solicitudes que corresponden a la fraseología utilizada en el ambiente de radiotelefonía e está de acuerdo con los requisitos de la OACI. El sistema tiene la capacidad de efectuar comunicaciones referentes a las requisiciones de nivel de vuelo (FL), cruzamientos, desvíos laterales, autorizaciones de ruta, tratamiento de velocidades, frecuencia, entre otras.

3.2.4 **Proceso de aprobación de aeronaves para enlace de datos**

Un punto importante para la operatividad del CPDLC y ADS-C se refiere al proceso de aprobación por lo cual deben pasar las aeronaves para que puedan utilizar los referidos servicios por medio de enlace de datos.

Como reflejado en la Sección 7.1 del Anexo 6 de la OACI (operación de aeronaves), en los espacios aéreos donde está prevista operaciones basadas en RCP, los aviones deberán estar autorizados por el Estado del explotador a realizar dichas operaciones en el referido espacio aéreo. Con eso, cuando se habla de CPDLC y ADS-C las aplicaciones tienen estrecha relación con los requisitos de performance definidos en el Doc 9869.

Asimismo, fue emitido el Reglamento Latino americano (LAR) 121 Capítulo H: Instrumentos y Equipos, que define un punto de especial interés en la garantía de la disponibilidad de los sistemas instalados y refleja que la instalación de los equipos será tal que la falla de cualquier unidad necesaria para los fines de comunicación no resultará en la falla de otra unidad necesaria.

En lo que respecta a las responsabilidades para la aprobación de las operaciones, a la autoridad del Estado de matrícula le corresponde determinar que la aeronave cumple con los requisitos CPDLC, ADS-C (certificación de aeronavegabilidad) y la aprobación del programa de mantenimiento, control de configuración etc. El cumplimiento de los requisitos de aeronavegabilidad no constituirá la aprobación operacional.

Además, a la autoridad del Estado del explotador le corresponde llevar a cabo la aprobación operacional y emitir la autorización para que un explotador pueda conducir operaciones CPDLC / ADS-C.

Para que sea ejecutada la aprobación, es necesaria una estrecha relación de la CAA con los explotadores de forma que se cumplan todos los requisitos necesarios. En relación a esto, el Manual del Inspector de Operaciones (MIO) del Sistema Regional para la Vigilancia de la Seguridad Operacional (SRVSOP) define cinco fases que deberían ser considerados por la CAA y explotadores:

- a) Fase 1 (Pre-solicitud): puede ser iniciada ya sea por la CAA o por el explotador. En esta fase el explotador hace las averiguaciones respectivas o solicita información a la CAA sobre el proceso de aprobación y la CAA convoca al explotador para una reunión donde serán discutidos todos los puntos para la aprobación de la operación CPDLC/ADS-C;
- b) Fase 2 (Solicitud Formal): presentación de la Solicitud Formal, la cual irá acompañada de una serie de documentos definidos en el MIO. La CAA puede aceptar o rechazar la Solicitud Formal para aprobación CPDLC / ADS-C, dependiendo de la forma, contenido y de la totalidad de la documentación requerida, una vez que haya revisado los documentos remitidos por el explotador;
- c) Fase 3 (Análisis de la Documentación) En esta fase, el equipo de la CAA debe llevar a término un análisis detallado de toda la documentación presentada junto con la Solicitud Formal;
- d) Fase 4 (Inspección y demostración): De acuerdo con los requerimientos de cada Estado, en esta fase se lleva a cabo las pruebas/vuelos de validación según el plan presentado; Y
- e) Fase 5 (Aprobación): Una vez que el explotador ha completado los requisitos de aeronavegabilidad, aeronavegabilidad continuada y de operaciones, la CAA emite la aprobación CPDLC / ADS-C.

4. APLICACIONES PRE FANS

4.1 Informaciones generales

El documento básico de referencia que define las características del enlace de datos ACARS aire-tierra es el AEEC 618 *Air-Ground Character-Oriented Protocol*. Este documento define el formato de texto de la aplicación orientada a carácter que puede ser transmitido en un enlace de datos ACARS. Como se ha mencionado en este documento, varios son los medios de transmisión del enlace de datos: SATCOM, VHF y HF.

Varias son las aplicaciones ATS que utilizan al ACARS para el establecimiento del enlace de datos aire-tierra, pero en esta guía serán explorados los conceptos principales que puedan ayudar a los Estados en la implantación del DCL, D-ATIS y D-VOLMET, que son sistemas en franca implantación en Brasil. Sin embargo, los componentes básicos que componen las soluciones son repetidos cualquiera que sea la aplicación.

En otras partes del documento se reflejó que los componentes de un enlace de datos se dividen en el subsistema de bordo, la subred terrestre y el enlace de datos aire-tierra propiamente dicho. Por supuesto, los equipos de bordo pertenecen a las empresas aéreas y que también pueden poseer la subred terrestre o contratar los servicios de un CSP. En lo que concierne a las estaciones remotas VHF, ellas normalmente pertenecen a un *Data Link Service Provider* (DSP) o al Proveedor Nacional de Navegación Aérea (ANSP), lo mismo sucediendo con los servidores utilizados para las aplicaciones PRE FANS.

Así, en este capítulo el principal contenido estará relacionado con los equipos que se conectan a la subred terrestre y que, efectivamente, proporcionan la posibilidad de tener el enlace de datos. Independientemente de a quien pertenezcan los servidores, lo que importa, siempre, es la confiabilidad de los servicios traducida por su disponibilidad.

La forma de implementación de las soluciones puede variar en términos de propiedad de los equipos servidores involucrados, ya que pueden pertenecer al ANSP/Estado o hacer parte de una prestación de servicios contratada de un DSP. El contenido presentado representa la experiencia de Brasil en la implantación del DCL, D-VOLMET y del D-ATIS, lo que pudiera servir de referencia a otros Estados.

4.2 ATIS y D-ATIS (Data-Link Automatic Terminal Information Service)

4.2.1 Introducción

El ATIS es un servicio predominantemente de difusión de informaciones por voz, destinado a aliviar la carga de trabajo del controlador de tráfico aéreo y la congestión de las frecuencias de control, suministrando informaciones de interés a las aeronaves en operación en el área terminal por medio de radiodifusión en frecuencia de VHF.

La información de ATIS es recibida por el piloto a través de una frecuencia específica para una determinada difusión en área terminal. Por su turno, el piloto escucha el mensaje grabado hasta que todos los datos pertinentes a la información sean entendidos. Después de la recepción, el piloto hace una copia de los datos de la información.

Los mensajes ATIS incluyen informaciones operacionales y meteorológicas que son actualizadas periódicamente o cuando hay modificaciones considerables. Los pilotos tienen que escuchar la frecuencia del ATIS antes del despegue y el momento de hacer los procedimientos para aproximación.

Normalmente, el procedimiento para la grabación de una nueva información de ATIS implica en tener contacto con las informaciones meteorológicas y operacionales, grabación en un medio de almacenamiento digital, chequeo de la información grabada y transmisión en radiodifusión de la nueva información.

Aunque sea de vital importancia para las operaciones de tráfico aéreo, el servicio tradicional provisto por el ATIS posee algunos inconvenientes:

- a) Cambios constantes de las condiciones atmosféricas causan un considerable aumento en la carga de trabajo del controlador;
- b) Las comunicaciones por voz pueden ocasionar problemas de entendimiento por parte del piloto;
- c) Las informaciones solamente están disponibles en el área de cobertura VHF.

Asimismo, uno de los inconvenientes es que en un ATIS el piloto tiene que escuchar toda la información antes que sea repetida. Debido a eso, el Anexo 11 de la OACI (Servicios de Tránsito Aéreo) tiene una recomendación de que los mensajes de ATIS no debieran exceder de 30 segundos, sin perjuicio (daño) para el entendimiento del contenido del mensaje.

La Figura 15 ilustra una arquitectura general de un sistema ATIS tradicional.

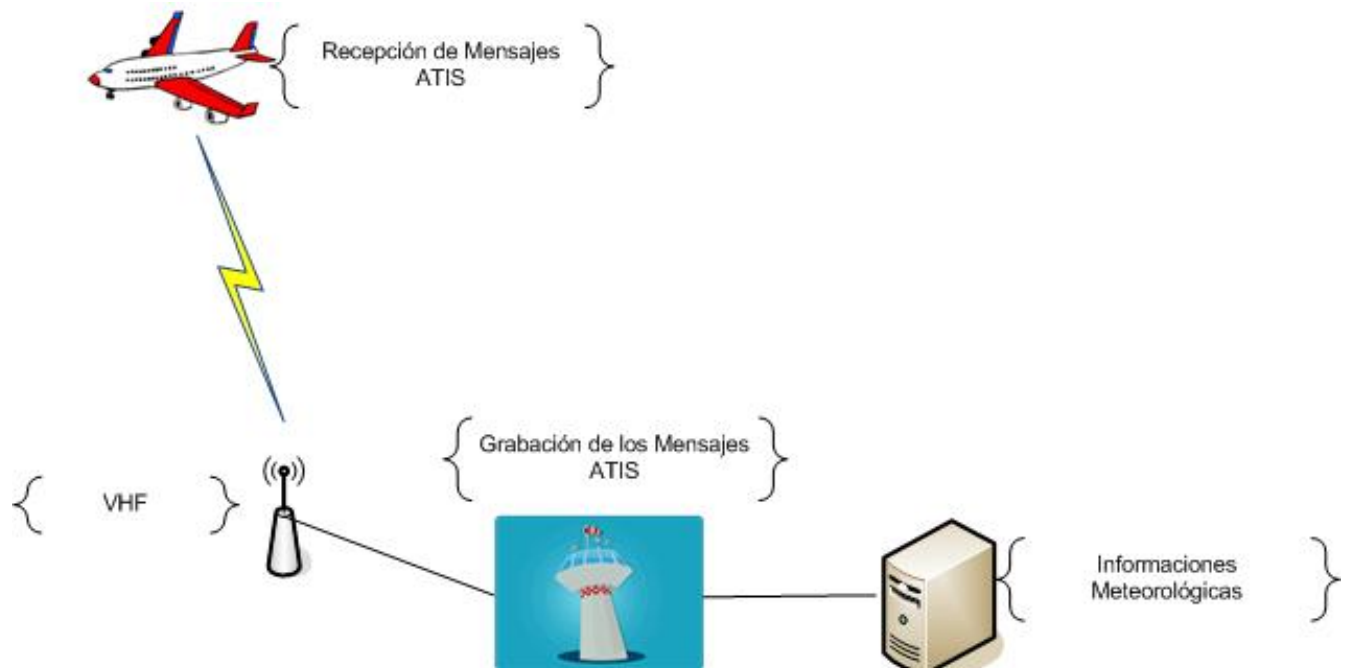


Figura 15: Arquitectura General del ATIS

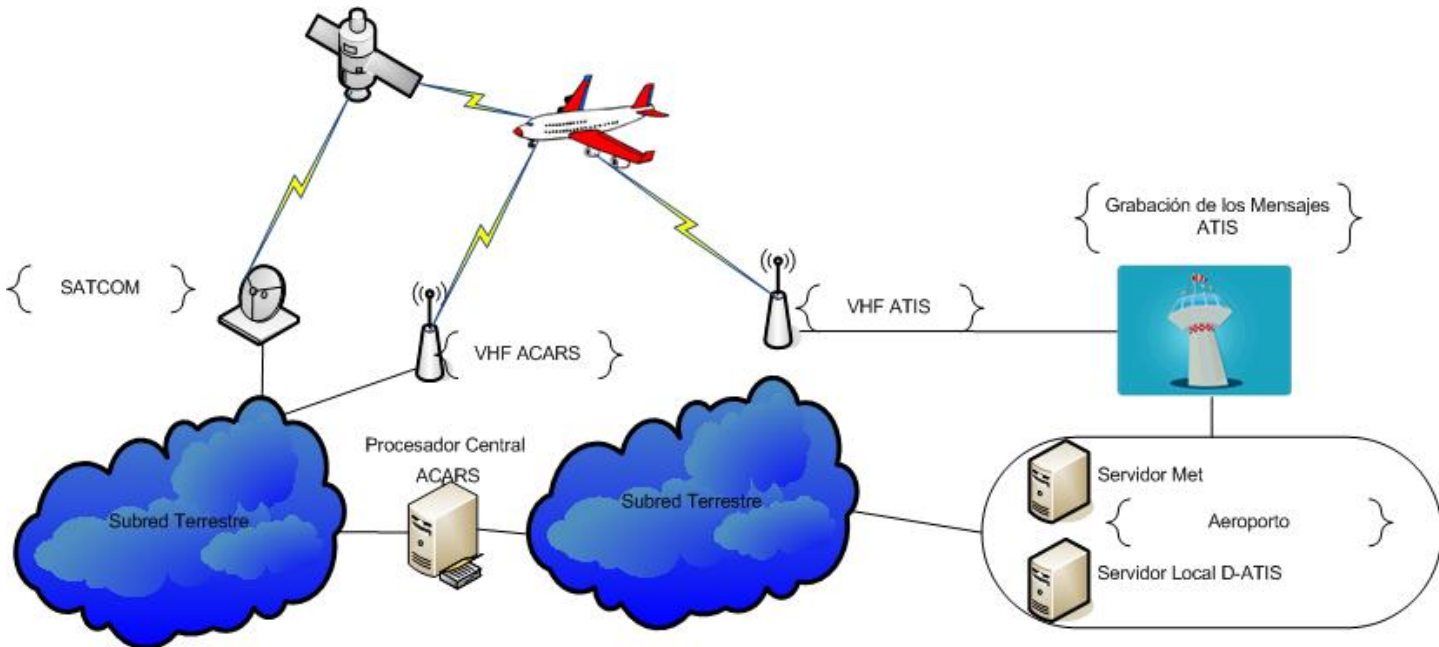
4.2.2 ATIS por enlace de datos (D-ATIS)

El servicio D-ATIS suministra informaciones de área terminal, actualizadas por comandos a partir de las dependencias de tránsito aéreo donde están instalados los equipos relacionados al servicio. Las informaciones ingresan en el sistema por medio de los teclados de computadoras.

La solución más simple puede ser adoptada por un ANSP cuando no se tiene muchos aeropuertos que justifiquen a la instalación del D-ATIS. La instalación de un D-ATIS consiste de servidores dobles, para garantizar la disponibilidad, en las instalaciones aeroportuarias que son alimentados por las fuentes de informaciones meteorológicas (METAR, SPECI o TAF), conforme sea el caso.

El D-ATIS presenta la ventaja de que el servidor también pueda generar el ATIS por radiodifusión con el uso de la voz por medio de grabación local de las informaciones. Por otro lado, la información de D-ATIS puede ser enviada por medio de la subred terrestre hasta el procesador central ACARS que podrá encaminar el mensaje a la aeronave por medio de un VHF ACARS o SATCOM. La Figura 16 ilustra, de forma general, la arquitectura básica.

Se enfatiza que la subred terrestre está representada por dos nubes solamente para fines de facilitación del entendimiento ya que, en términos prácticos, es solamente una red de comunicaciones



normalmente contratada de un CSP

Figura 16: Arquitectura General de D-ATIS para un Aeródromo

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Cuando se instala un D-ATIS en un Estado se puede empezar con la topología demostrada en la Figura 16. Para la implementación de D-ATIS para aeropuertos múltiples, hay soluciones que representan ventajas en términos financieros. La técnica más empleada consiste de la instalación de un servidor central, en configuración doble, que puede recibir informaciones de varios de aeropuertos remotos. La Figura 17 trae la configuración descripta.

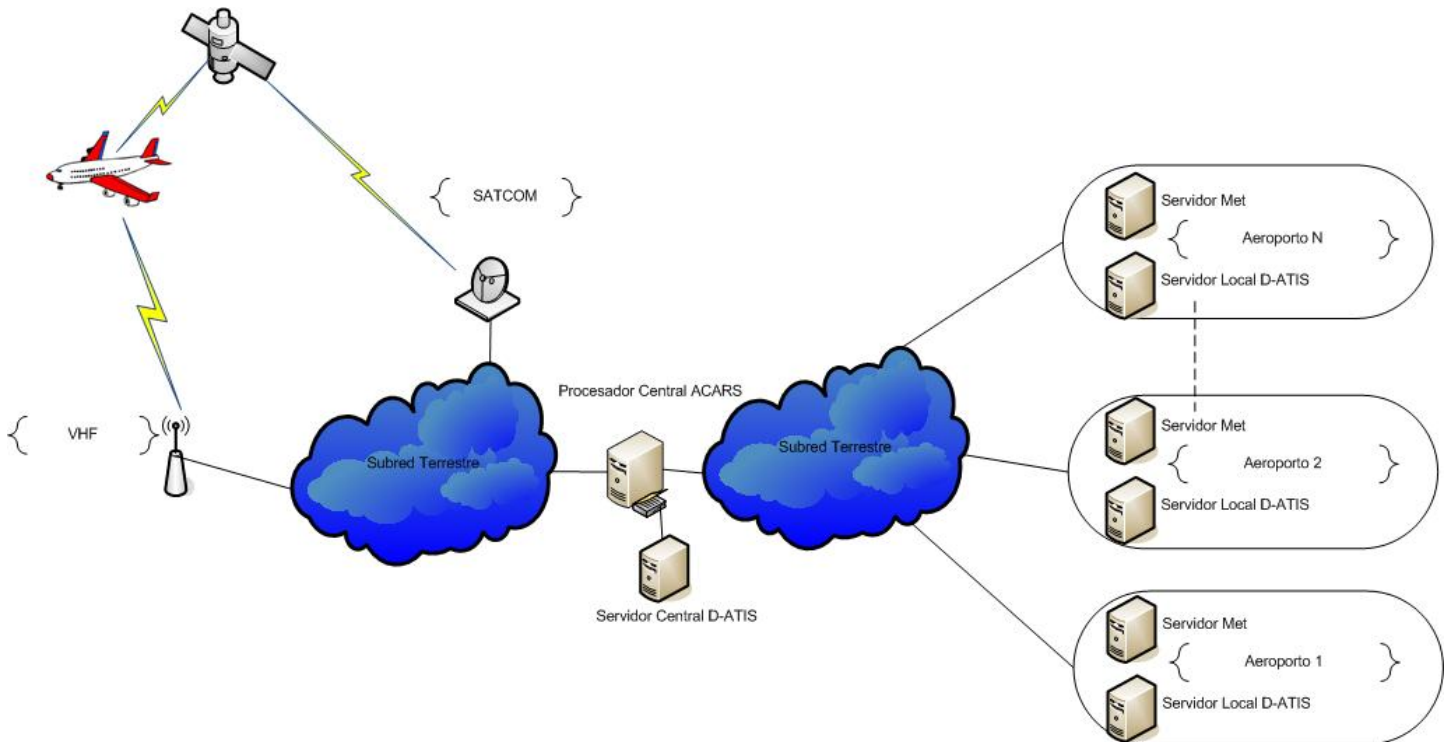


Figura 17: Arquitectura de D-ATIS con Procesador Centralizado

Cabe mencionar la importancia de la instalación del servidor central en una localidad de alta disponibilidad, no solamente en términos del servidor sino, también, de infraestructura (electricidad, climatización) que puede, por ejemplo, ser el *data center* principal del ANSP. Si el modelo adoptado por un Estado es que se provea el servicio de *data-link* y de aplicaciones ATS, se sugiere que el procesador central ACARS esté ubicado en las mismas instalaciones del procesador central del D-ATIS.

4.3 VOLMET y D-VOLMET

4.3.1 Introducción

De acuerdo con lo que consta en el Anexo 3 de la OACI, el Servicio de Información Meteorológica para Aeronaves en Vuelo (VOLMET) provee a las aeronaves en vuelo informaciones de METAR, SPECI, TAF y SIGMET actuales por medio de radiodifusores orales continuos y repetitivos.

Las tripulaciones necesitan, constantemente, de datos meteorológicos relativos a los aeródromos de salida, de llegada, alterno, así como de la ruta pretendida para que se realice un planeamiento adecuado de sus vuelos.

La información meteorológica para la planificación por parte del explotador para sus aeronaves en vuelo se proporcionará, a solicitud, según se convenga entre la autoridad o las autoridades meteorológicas y el explotador interesado con la utilización de VHF o HF. Con eso, se exige atención especial de la tripulación para el entendimiento del texto y la transcripción, porque las informaciones son susceptibles a errores de interpretación y pueden presentar dificultades de recepción debido a posibles interferencias en la señal

Para que se tenga una idea del esfuerzo empleado para que se provea el servicio de VOLMET, se presenta, en la Figura 18, la cobertura VHF en territorio brasileño para el FL 300.

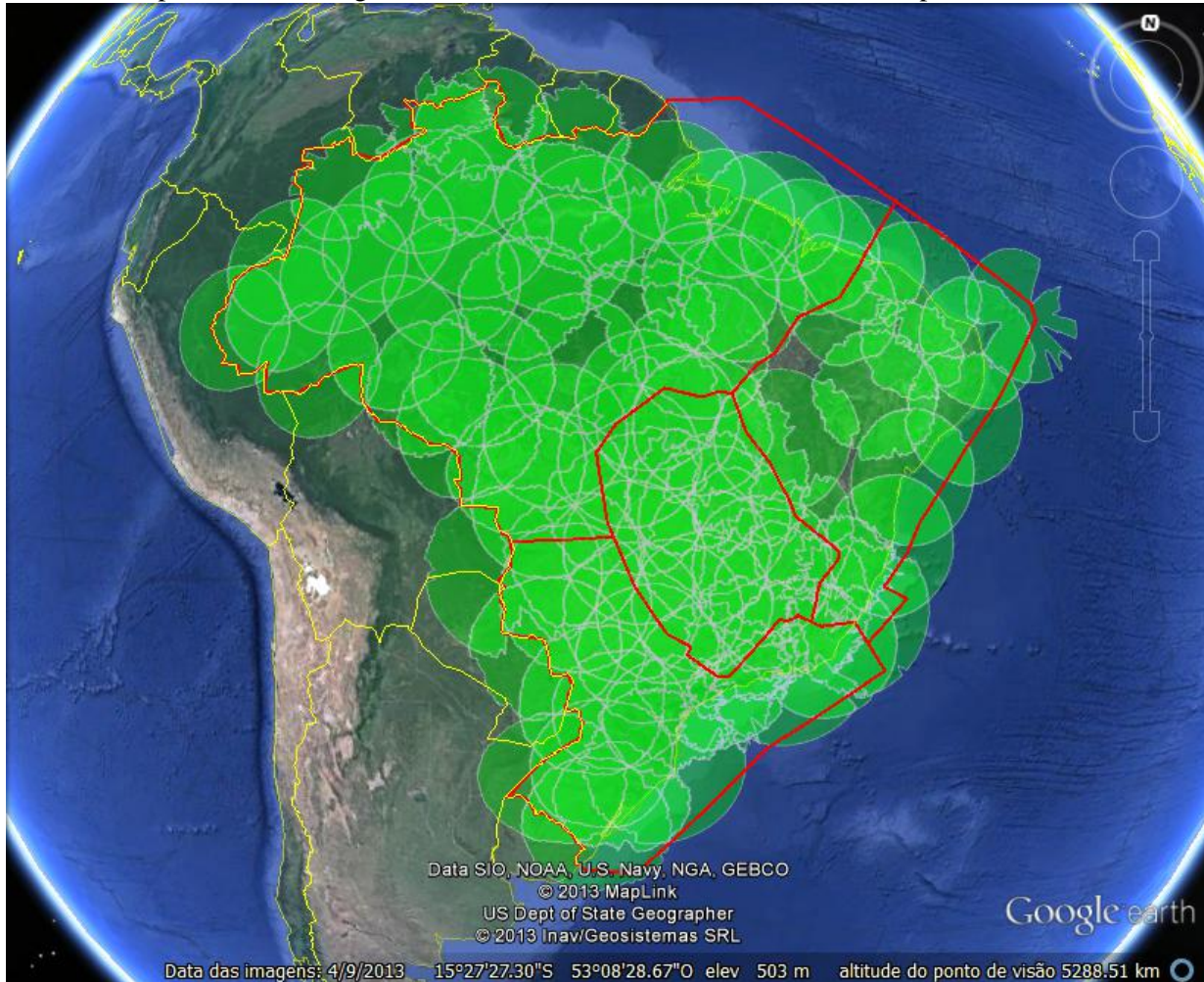


Figura 18: Cobertura VHF VOLMET en Brasil

En resumen, se tiene casi un ciento de equipos VHF por todo el territorio brasileño de modo que se tenga una cobertura compatible con las FIR continentales solamente para el servicio de VOLMET. Además de las cuestiones de mantenimientos y de logística, cabe enfatizarse que en los ACC de Brasil se provee el servicio en consolas operadas por meteorólogos que se revezan en la posición operacional.

4.3.2 VOLMET por enlace de datos (D-VOLMET)

El D-VOLMET amplía la confiabilidad del VOLMET convencional, pues la utilización de mensajes por medio de datos, en la forma escrita, facilita la recepción y la interpretación del contenido, además de reducir la carga de trabajo de pilotos y de controladores de tránsito aéreo.

En el caso de Brasil, se vislumbra la posibilidad de sustituirse el servicio convencional por el provisto por medio del enlace de datos. Así, desde octubre de 2012 el D-VOLMET fue puesto en operación en Brasil.

Con el sistema D-VOLMET, los datos meteorológicos son transmitidos por intermedio de la red de enlace de datos ACARS así que son requeridos por la tripulación con el uso del equipo de bordo MCDU. La información meteorológica será exhibida en el *display* y podrá ser impresa en cualquier momento. Eso representa un incremento considerable en la eficiencia y seguridad de las actividades de vuelo, pues minimiza la carga de trabajo del piloto y elimina los posibles errores de interpretación del mensaje. La Figura 19 describe la interface de entrada de requisiciones MCDU para las tripulaciones.

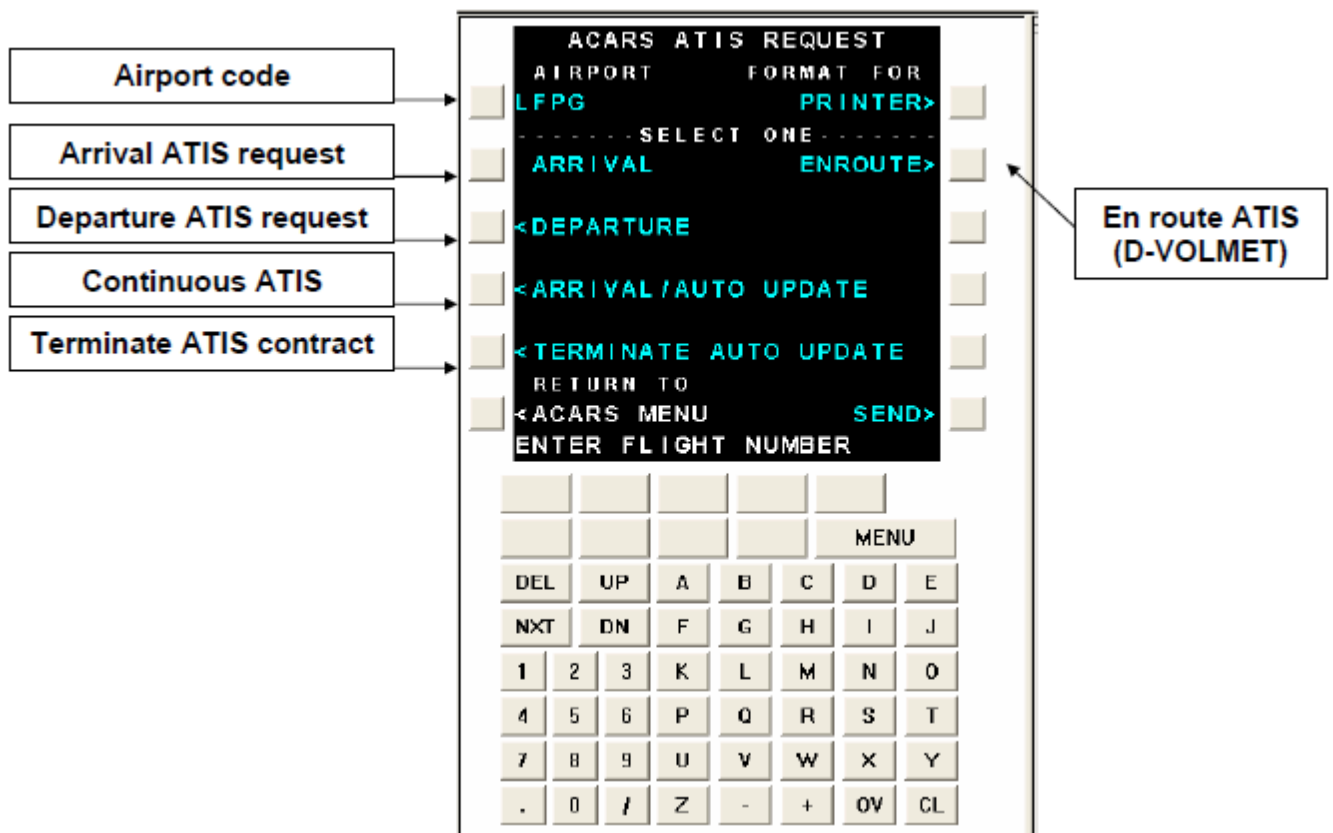


Figura 19: Equipo MCDU para la Entrada de Requisiciones de Mensajes ACARS

Como descrito en la Figura 19, el equipo MCDU permite que el piloto seleccione la opción correspondiente al D-VOLMET y digite el código de la localidad referente al aeropuerto o FIR de interés para el vuelo.

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Al insertar un indicativo de localidad de FIR, el servicio de información D-VOLMET suministra los respectivos mensajes SIGMET que esté en vigor en la respectiva FIR, lo que es presentado en la pantalla. Cuando ningún mensaje esté disponible, es presentado un mensaje NIL SIGMET.

Por su turno, cuando se insiere un indicativo de localidad de un aeródromo, el servicio D-VOLMET suministra los mensajes METAR/SPECI o TAF

En términos de infraestructura de servidores para la implantación del D-VOLMET, se puede tomar en cuenta que las informaciones serán almacenadas en un servidor de banco de datos meteorológicos, siendo que en Brasil el nombre de dicho banco de datos es llamado de Banco OPMET, que es alimentado por la INTERNET o por la INTRANET del *Departamento de Controle do Espaço Aéreo* (DECEA) a partir de las fuentes de datos provenientes de los aeropuertos.

La Figura 20 da un resumen de la topología. En la figura las requisiciones enviadas por la tripulación son conmutadas por el Procesador Central y llegan al Servidor Central de Meteorología. A partir de este punto, las consultas son hechas al Banco de Datos de Meteorología, lo que puede también pasar por una subred de comunicaciones terrestre.

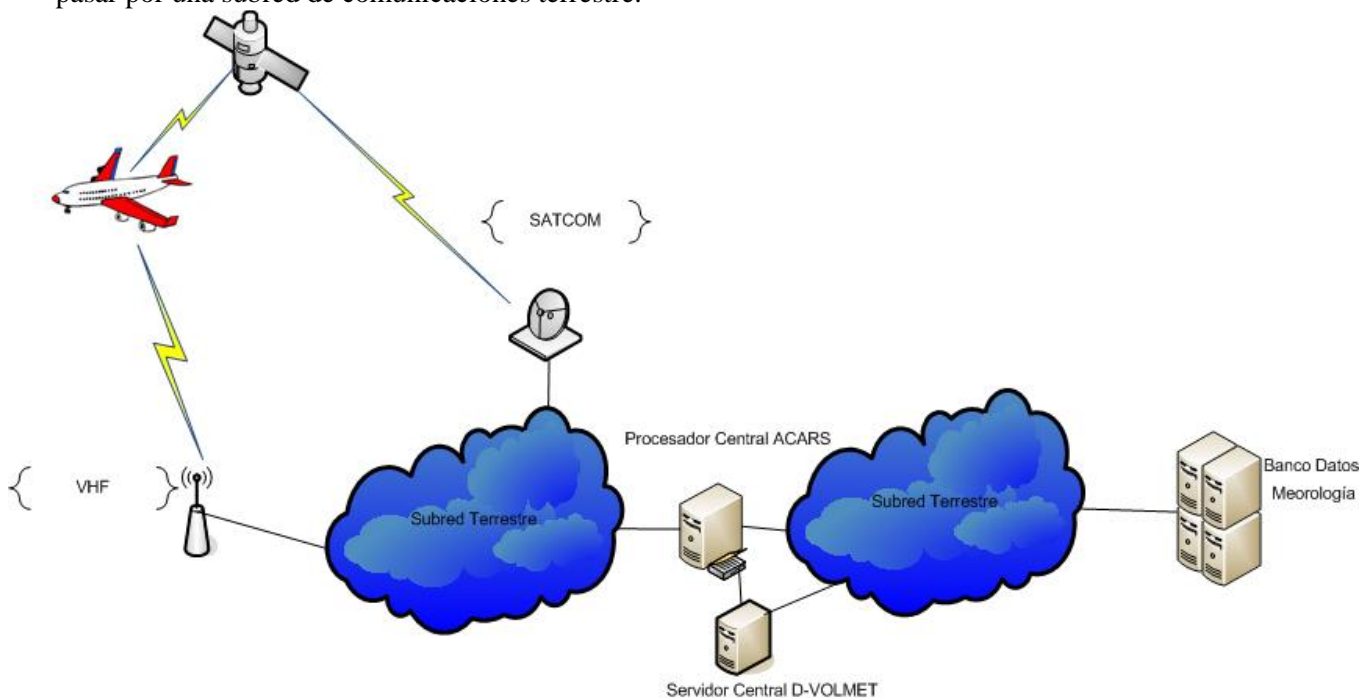


Figura 20: Arquitectura Básica del Sistema D-VOLMET

4.4 Departure Clearance (DCL)

En las operaciones de *Clearance* convencional el piloto presenta su plan de vuelo y después de terminar el chequeo de pre vuelo llama a la posición referente de la torre de control, en una frecuencia VHF, y solicita informaciones sobre la posible aprobación del plan de vuelo.

Por su turno, el controlador de tránsito aéreo reconoce la llamada y chequea las condiciones referentes al plan de vuelo en su pantalla. Después el controlador llama al piloto y lee la información de *clearance*. Caso autorizado, el piloto llama a la posición concerniente para la solicitud de la autorización para la partida de los motores.

Todo el proceso representa demasiada carga de trabajo, principalmente en la hora pico, pérdida de tiempo para la tripulación y controladores, además de poder ocurrir problemas de interpretación del contenido de las informaciones.

Como ocurre con las otras aplicaciones de enlace de datos, el uso de DCL representa un incremento considerable en la eficiencia y seguridad de las actividades de vuelo, pues minimiza la carga de trabajo del piloto y elimina los posibles errores de interpretación del mensaje.

La Figura 21 presenta una arquitectura posible para el DCL. Como ejemplo práctico de Brasil, donde el DCL está siendo paulatinamente implantado, las operaciones de *clearance* tuvieron una disminución de tiempo de algunos minutos para menos de un minuto en los aeropuertos que ya tienen el servicio operacional.

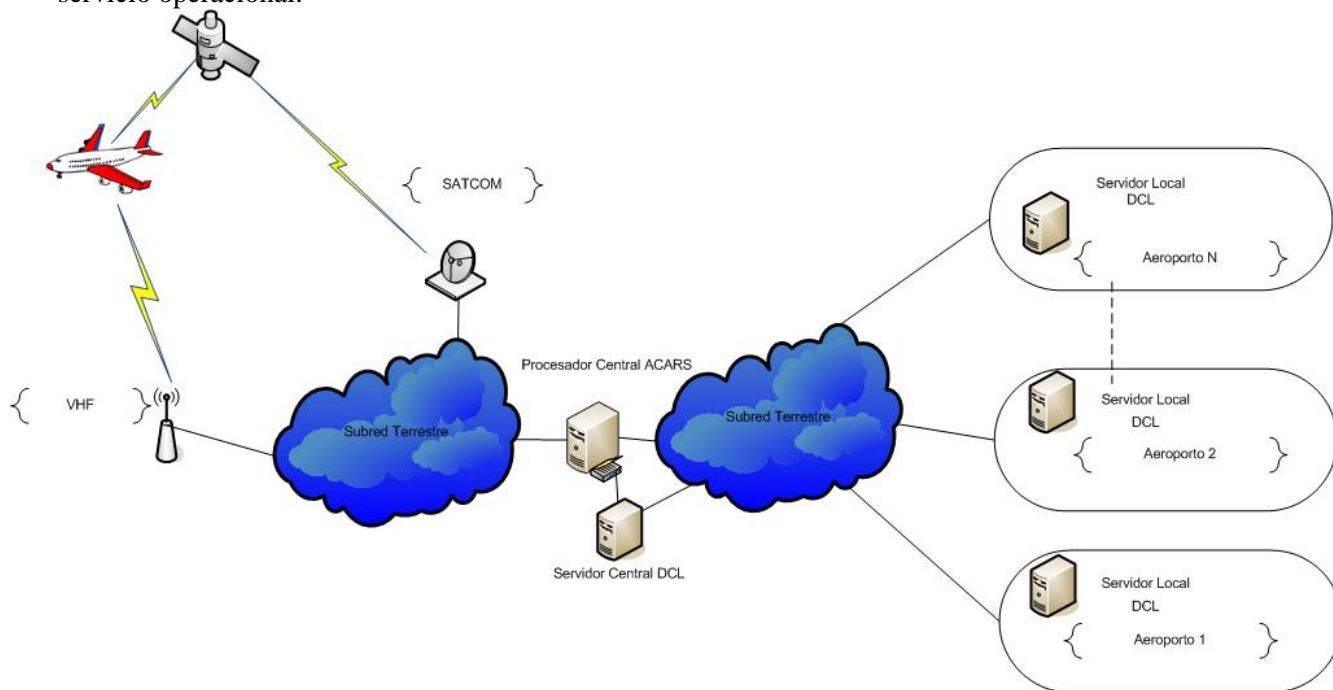


Figura 21: Arquitectura Básica para DCL

Una observación importante y que puede representar un ahorro de costos en la inversión necesaria es que el Servidor Central DCL, D-ATIS y D-VOLMET pueden ser un mismo equipo. Lógicamente, para que se garantice los requisitos de disponibilidad compatibles con el Doc 9694 se sugiere que sean instalados equipos servidores dobles en el *data center* correlato.

5. CONSIDERACIONES A LOS ESTADOS PARA LA IMPLANTACIÓN DE ENLACE DE DATOS

5.1 Consideraciones generales contribuyentes a la toma de decisiones

La decisión para la implantación de enlace de datos en los Estados de la Región SAM involucra una serie de factores claves que serán presentados en este capítulo. Es importante tomar en cuenta que la decisión no lleva en consideración solamente aspectos técnicos y operacionales, sino aquellos referentes a la política y estrategia de un Estado concerniente a la implantación de su infraestructura de soporte a los enlaces de datos y a las aplicaciones concernientes.

5.1.1 Concepción operacional

Conforme mencionado en la **Sección 2.1 (Introducción)**, el establecimiento de una Concepción Operacional ATM en un Estado es el punto de partida para la implantación de enlace de datos. Los Estados no están aislados y en el concepto del espacio aéreo continuo las iniciativas regionales y globales, en esta orden, deben ser consideradas. Con esto, lo ideal es que al inicio se considere el contenido del Plan de Implantación del Sistema de Navegación Aérea Basado en Rendimiento para la Región SAM (SAM PBIP) y la Cuarta Edición del Plan mundial de navegación aérea, 4ª Edición (GANP) (Doc 9750).

Las instituciones relacionadas con la gestión de tránsito aéreo (CAA, ANSP), deberían desarrollar una estrategia de evolución destinada a proporcionar beneficios para la comunidad ATM con implementación ordenada, segura y con una relación costo beneficio favorable. Debe ser llevado en cuenta que la evolución de la implantación de la concepción desarrollada está relacionada a la capacidad instalada a bordo de las aeronaves, conforme descrito en la **Sección 2.3 (Equipos de Bordo)**.

5.1.2 Implantación de la subred aire-tierra

En la **Sección 2.4 (Infraestructura Tierra-Aire)** se trata de las posibilidades para la implantación de las arquitecturas aire-tierra, donde se reflejan las posibilidades de que los equipos de VHF sean de propiedad de la CAA o del proveedor de servicios DSP. También fue tratada la decisión de Brasil para modernización de la plataforma de enlace de datos por medio de concesión de los servicios, cuyos aspectos principales están el **Apéndice F**.

En lo que respecta a los aspectos técnicos, la toma de decisión del nivel de vuelo (FL) de cobertura global del territorio de un Estado es clave, pues determina la cantidad de estaciones remotas que serán instaladas y, como ejemplo, se cita el caso de Brasil donde se decidió por la cobertura en el FL 245. También en la **Sección 2.4 (Infraestructura Tierra-Aire)**, son tratados los aspectos técnicos que podrían ser considerados por los Estados en la implantación de los equipos VHF (ACARS, VDL *Mode 2*).

En todo el texto, en especial en las Secciones **2.4 (Infraestructura Tierra-Aire)** y **3.2 (Enlace de Datos en el Área Oceánica – ACC-AO Brasil)** se mencionó que en áreas oceánicas solamente es posible la utilización de SATCOM y HF DL. Por ende, esto es un punto clave en la toma de decisión del modelo de implantación de la infraestructura en el área continental por VHF (ACARS y/o VDL *Mode 2*) principalmente por las cuestiones financieras involucradas en las inversiones en estaciones remotas y equipos de bordo. Si una CAA decide por la política de implantación de estaciones remotas en su país, es importante que los explotadores comprendan las ventajas (financiera, técnica y operacional) en la utilización de la plataforma al revés del uso, por ejemplo, de SATCOM.

Como todos los equipos de telecomunicaciones, la tecnología evoluciona y los Estados y CAA deberían llevar en cuenta las acciones de la OACI y programas individuales de Estados y Regiones en lo que concierne a las nuevas arquitecturas, conforme detallado en la **Sección 2.4.3 (Future Communication Infrastructure)**.

5.1.3 **Implantación de la subred tierra-tierra**

En la **Sección 2.5 (Subredes de Comunicación Tierra-Tierra)** se presentan aspectos importantes que debieran ser tomados en consideración para garantizar la disponibilidad de la subred terrestre como parte de la cadena fin a fin entre las aeronaves y dependencias ATC.

Asimismo, considerando que las subredes tierra-tierra son basadas en IP, se mencionan los principales documentos que deberían ser tomados en cuenta por la Región y Estados en la implantación de las redes tales como: el Doc OACI 9896 – Manual para la Red de Telecomunicaciones Aeronáuticas (ATN), Guía de Orientación para la Implementación de Redes Nacionales Digitales en Protocolo IP, Política de Enrutamiento para la Región SAM y Guía de Orientación de Seguridad para la Implantación de Redes IP.

5.2 **Consideraciones específicas para la implantación de CPDLC y ADS-C**

En la **Sección 3.2 (Enlace de Datos en el Área Oceánica – ACC-AO Brasil)**, se destacó que para la implementación de CPDLC y ADS-C los sistemas que podrían ser tomados en cuenta por los Estados que poseen FIR oceánicas deben ser dotados de capacidad de visualización y tratamiento de planes de vuelo, bien como la capacidad de realizar el acompañamiento de la progresión de vuelos, realizar la predicción de conflictos en trayectorias fijas y aleatorias, tratamiento automatizado de mensajes FPL y capacidad de emitir alertas en situaciones de conflicto de corto y medio plazos, además de ser capaz de cambiar mensajes automáticamente con los centros continentales limítrofes.

Con respecto a la visualización de los datos ADS-C, debería estar disponible en todas las consolas de operación, integrada con las informaciones de los radares de vigilancia.

Además, considerando la posibilidad de que haya aeronaves no equipadas con la capacidad de enlace de datos para las aplicaciones de CPDLC y ADS-C, se debería mantener equipos HF que puedan dar la mayor disponibilidad posible, teniendo en cuenta los problemas de propagación descriptos.

Cabe decir que mientras no se tenga la Red ATN implantada, el uso de CPDLC y ADS-C con el uso de ACARS podría ser utilizada por los Estados en rutas continentales remotas, siguiendo la concepción operacional establecida en un Estado en consonancia a las acciones que serían necesarias por los explotadores para la instalación de la aviónica correlata y la dotación de los sistemas necesarios en las dependencias ATC involucradas.

Por fin, la Sección 3.2 trata de las responsabilidades de las CAA y explotadores para que se tenga la operatividad de los servicios de CPDLC y ADS-C y las acciones que deberían ser tomadas por base en la hora de aprobarse los procedimientos, de acuerdo al establecido en el Anexo 6 de la OACI, el Reglamento Latino americano (LAR) 121 Capítulo H : Instrumentos y Equipos y en el Manual del Inspector de Operaciones (MIO) del SRVSOP:

5.3 **Consideraciones específicas para la implantación de aplicaciones PRE FANS**

En el **Capítulo 4 Aplicaciones PRE FANS**, fueron considerados los requisitos básicos para la implantación de las aplicaciones orientadas a carácter y las ventajas en relación a los servicios tradicionales.

Específicamente, las principales aplicaciones que deberían ser consideradas por las CAA serían el D-VOLMET, D-ATIS y DCL. La implantación de los servicios involucra la instalación de servidores que pueden ser de propiedad de una CAA, ANSP o DSP.

La decisión para ejecutar la implantación de los servidores debe llevar en consideración aspectos económicos, técnicos y operacionales. Debe ser observado que mientras se tenga pocos aeropuertos con las funcionalidades de enlace de datos, puede adoptarse la solución de servidores locales para D-ATIS y DCL. Si el número de aeropuertos es considerable, se debiera llevar en cuenta la implantación de servidores centrales que recibirían las informaciones de los remotos y las enviarían, por intermedio del procesador central, hacia las estaciones remotas.

Con relación al servicio de D-VOLMET, se considera conveniente la instalación de un banco de datos central, como el Banco OPMET de Brasil, que reciba las informaciones de los aeropuertos y las transmitan, bajo demanda, a las aeronaves, pasando por el procesador central.

APENDICE A**ENLACE DE DATOS EN EL PLAN DE IMPLANTACIÓN DEL SISTEMA DE NAVEGACIÓN
AÉREA BASADO EN RENDIMIENTO PARA LA REGIÓN SAM (SAM PBIP)****1. B0-40 TBO: Mayor seguridad operacional y eficiencia mediante la aplicación
inicial de servicios de enlace de datos en ruta****Introducción**

1.1 Los intercambios de datos aire-tierra han sido objeto de décadas de investigación y de trabajo de normalización, y son un ingrediente esencial de los conceptos operacionales futuros, ya que pueden transmitir de manera fiable información más completa que la que se puede transmitir por radio. Existen muchas tecnologías que se han instalado extensamente en las aeronaves, con frecuencia también por razones de control de las operaciones aeronáuticas (AOC) y de comunicaciones administrativas de las líneas aéreas (AAC). En años recientes se han empezado a ver en ATM varias aplicaciones, pero no se han implementado totalmente. Además se está trabajando para asegurar que las aplicaciones sean interoperables con distintos sistemas de aeronave, tarea que está realizando con prioridad el Grupo de expertos sobre enlaces de datos operacionales (OPLINKP). Este módulo incluye lo que está disponible y puede usarse ya de manera más generalizada.

1.2 Un elemento del módulo es la transmisión de información sobre la posición de la aeronave, constituyendo el contrato de la vigilancia dependiente automática (ADS-C), principalmente para áreas oceánicas y remotas en donde por razones físicas o económicas no puede instalarse un radar.

1.3 Un segundo elemento son las comunicaciones por enlace de datos controlador-piloto (CPDLC) que incluye un primer conjunto de aplicaciones de enlace de datos que permite que los pilotos y los controladores intercambien mensajes de ATC sobre manejo de las comunicaciones, autorizaciones de ATC y micrófonos trabados. Las CPDLC reducen los malos entendidos, así como el volumen de trabajo del controlador, aumentando la seguridad y la eficiencia y al mismo tiempo dando capacidad adicional al sistema ATM.

Línea de base

1.4 Antes de este módulo las comunicaciones aire-tierra se hacían por radio (VHF o HF dependiendo del espacio aéreo), con limitaciones en términos de calidad, ancho de banda y seguridad. También hay grandes extensiones en el mundo sin vigilancia de radar. Las instrucciones de ATC, los informes de posición y otra información deben transmitirse por radio en HF, con una calidad de la voz particularmente deficiente la mayor parte del tiempo, lo cual conduce a un aumento considerable del trabajo de los controladores y de los pilotos (incluyendo a los operadores de radio HF), un conocimiento deficiente de la situación del tráfico fuera de la cobertura radar, separaciones mínimas grandes y malos entendidos. En un espacio aéreo de alta densidad, los controladores actualmente pasan el 50% de su tiempo hablando con los pilotos por los canales de voz VHF, cuyas frecuencias son un recurso escaso; esto también representa un trabajo considerable para los pilotos y controladores y una fuente de malos entendidos.

Cambios introducidos por el módulo

1.5 En este módulo se implementa un primer conjunto de aplicaciones de enlace de datos que cubre ADS-C, CPDLC y otras aplicaciones para ATC. Éstas mejoran significativamente la forma de prestar ATS, como se describe en la siguiente sección.

1.6 Un objetivo importante del concepto operacional de ATM mundial en cuanto a los enlaces de datos es armonizar las implementaciones regionales y acordar una definición técnica y operacional común, aplicable a todas las regiones de vuelo en el mundo. Esto se prevé lograr mediante los cambios del Bloque 1. Por el momento, la utilización del enlace de datos se basa en normas, tecnología y procedimientos operacionales diferentes, aunque hay muchas similitudes.

Elemento 1: ADS-C en áreas oceánicas y remotas

1.7 La ADS-C presta un servicio de vigilancia dependiente automática en áreas oceánicas y remotas, utilizando los mensajes de posición que envían automáticamente las aeronaves por enlace de datos, a intervalos de tiempo específicos. Esta mejor conciencia de la situación (combinada con niveles apropiados de PBN) está mejorando la seguridad operacional en general y permite reducir la separación entre aeronaves y alejarse progresivamente de los medios de control puramente por procedimientos.

Elemento 2: CPDLC continental

1.8 Esta aplicación permite que los pilotos y controladores intercambien mensajes con una transmisión de mejor calidad. En particular, presenta una forma de alertar al piloto cuando el micrófono está trabado, y un medio de comunicaciones complementario. Las CPDLC se usan como medio de comunicaciones suplementario. El medio primario sigue siendo el de las comunicaciones de voz.

1.9 En espacio aéreo continental denso, pueden reducir significativamente el volumen de las comunicaciones, lo cual permite que el controlador organice mejor sus tareas, en particular al no tener que interrumpirlas para responder inmediatamente a una radiocomunicación. Son un medio más fiable para la transmisión y la comprensión de los cambios de frecuencias, niveles de vuelo, información de vuelo, etc., que aumenta la seguridad operacional y reduce el número de malos entendidos y repeticiones.

Mejoras operacionales previstas

1.10 En el *Manual sobre la actuación mundial del sistema de navegación aérea* (Doc 9883) se proponen parámetros para medir el éxito del módulo.

Elemento 1: ADS-C en áreas oceánicas y remotas

Capacidad

1.11 Mejor localización del tránsito y reducciones en la separación que aumentan la oferta de capacidad.

Eficiencia

1.12 Las rutas/derrotas y vuelos pueden tener separaciones mínimas reducidas, lo cual permite las rutas flexibles y perfiles verticales más cercanos a los preferidos por los usuarios.

Flexibilidad

1.13 La ADS-C facilita los cambios de ruta

Seguridad operacional

1.14 Mayor conciencia de la situación; redes de seguridad basadas en la ADS-C, tales como supervisión del respeto de los niveles y rutas autorizados, advertencia de penetración en zona de peligro; más apoyo para búsqueda y salvamento

Análisis de costo/beneficio

1.15 El estudio económico ha resultado positivo debido a las ventajas que obtienen los vuelos en términos de eficiencia de vuelo (mejores rutas y perfiles verticales; mejor resolución táctica de conflictos). Cabe señalar la necesidad de sincronizar la instalación en tierra y a bordo para asegurar que se presten los servicios de tierra cuando las aeronaves estén equipadas, y que una proporción mínima de vuelos en el espacio aéreo considerado esté debidamente equipada.

Elemento 2: CPDLC continental**Capacidad**

1.16 Reducción de las comunicaciones y mejor organización del trabajo del controlador, lo cual permite aumentar la capacidad del sector.

Seguridad operacional

1.17 Mayor conciencia de la situación; menos malos entendidos; solución a las situaciones de micrófonos trabados.

Análisis de costo/beneficio

1.18 Debe tomar en consideración:

- a) las ventajas para los vuelos en términos de eficiencia de vuelo (mejores rutas y perfiles verticales; mejor resolución táctica de conflictos); y
- b) menos volumen de trabajo para el controlador y mayor capacidad.

Procedimientos necesarios (aire y tierra)

1.19 Se describieron procedimientos, y se incluyeron en el *Manual de aplicaciones de enlace de datos para los servicios de tránsito aéreo* (Doc 9694) y en el Documento de orientaciones mundiales para las operaciones por enlace de datos (GOLD) de la OACI. Actualmente se están fusionando las orientaciones operacionales del GOLD y LINK2000+ en una actualización del GOLD que contempla la aplicabilidad mundial, independientemente del espacio aéreo y la tecnología.

Capacidad necesaria del sistema

Aviónica

1.20 Ya se cuenta con normas para esta tecnología en documentos de la OACI y normas de la industria. En la actualidad las aplicaciones de enlace de datos se basan en dos conjuntos de servicios ATS de enlace de datos: FANS 1/A y ATN B1, que seguirán existiendo. El FANS1/A se usa en regiones oceánicas y remotas, mientras que ATN B1 se está implantando en Europa de conformidad con la legislación de la Comisión Europea (EC Reg. No. 29/2009) – la reglamentación para la implantación de servicios de enlace de datos.

1.21 Estos dos paquetes tienen diferencias en términos operacionales, de seguridad y de rendimiento, y no comparten la misma tecnología, pero hay muchas similitudes y pueden integrarse gracias a la resolución de algunos problemas operacionales y técnicos mediante soluciones provisionales como la aceptación de los sistemas FANS 1/A de aeronave en las instalaciones ATN B1 en tierra y doble instalación (FANS 1/A y ATN B1) en la aeronave.

Sistemas terrestres

1.22 La tecnología necesaria en los sistemas terrestres incluye la capacidad de administrar contratos ADS-C y de procesar y presentar los mensajes de posición de ADS-C. Los mensajes de CPDLC deben procesarse y presentarse en la dependencia pertinente de ATC. La vigilancia, mejorada por la fusión de datos de varios sensores, facilita la transición hacia/desde el entorno radar.

Consideraciones de factores humanos

1.23 La ADS-C es un medio para presentar al controlador del tránsito aéreo una representación directa de la situación del tráfico y reducir el trabajo de los controladores o los radiooperadores de recopilar los informes de posición. Además de establecer otro canal de comunicaciones, las aplicaciones de enlace de datos permiten, en particular, que los controladores organicen mejor su trabajo táctico. Tanto los pilotos como los controladores se benefician de un menor riesgo de mala comprensión en comparación con las comunicaciones orales.

1.24 Las comunicaciones de datos reducen la congestión de los canales de voz, mejoran la comprensión y permiten un manejo más flexible de los intercambios de información aire-tierra. Esto implica una evolución en el diálogo entre pilotos y controladores, quienes deben entrenarse para usar el enlace de datos en lugar de las radiocomunicaciones. Tanto el piloto como el controlador requieren apoyo de la automatización. En general sus responsabilidades respectivas no cambiarán.

1.25 Los factores humanos se tuvieron en cuenta durante la etapa de desarrollo de los procesos y procedimientos de este módulo. Al prever la automatización, se consideró la interfaz entre el ser humano y la máquina desde las perspectivas funcional y ergonómica. Sin embargo, todavía existe la posibilidad de que haya fallas latentes, y se requiere atención durante toda la actividad de implementación. A este respecto se pide que cualquier problema relacionado con factores humanos que se identifique durante la implementación se notifique a la comunidad internacional, por conducto de la OACI, como parte de cualquier iniciativa de informes sobre seguridad operacional.

Requisitos de instrucción y competencia

1.26 El piloto y el controlador requerirán apoyo automatizado, por lo cual tendrán que capacitarse para trabajar en el nuevo entorno y para identificar las aeronaves e instalaciones que pueden manejar servicios de enlace de datos en entornos mixtos.

1.27 Para este módulo se requiere instrucción sobre las normas y procedimientos operacionales que figuran en los documentos citados en la sección “Documentos de referencia y textos de orientación” de este módulo. Asimismo, los requisitos en términos de competencia se identifican en los requisitos normativos en los párrafos 15.28 a 15.30.

Necesidades de reglamentación/normalización y plan de aprobación (aire y tierra)

1.28 Reglamentación/normalización: utilizar los requisitos actuales publicados que incluyen los mencionados en la Sección 8.4. Debe también tomarse nota de que se están preparando las nuevas orientaciones OPLINK OPS de la OACI.

1.29 Planes de aprobación: deben coincidir con los requisitos de aplicación.

1.30 El grupo de trabajo *ad hoc* GOLD está trabajando en una actualización del GOLD-Ed 1 en el contexto de la armonización de procedimientos independientemente del espacio aéreo y de la tecnología.

Documentos de referencia y textos de orientación

- Doc 9694 de la OACI, *Manual de aplicaciones de enlace de datos para los servicios de tránsito aéreo*.
- Documento de orientaciones mundiales para las operaciones por enlace de datos (GOLD) Ed 2 (en preparación)
- Regla de la Comisión (CE) No 29/2009 del 16 de enero de 2009 que establece los requisitos relativos a los servicios de enlace de datos para el cielo único europeo.
- EUROCAE ED-100A/RTCA DO-258A, Requisitos de interoperabilidad para aplicaciones ATS usando comunicaciones de datos ARINC 622.
- EUROCAE ED-110B/RTCA DO-280B, Norma de requisitos de interoperabilidad para la red de telecomunicaciones aeronáuticas, *Baseline 1* (Interop ATN B1).
- EUROCAE ED-120/RTCA DO-290, Norma de requisitos en seguridad y funciones para los servicios iniciales de enlace de datos para tránsito aéreo en espacio aéreo continental (SPR IC).

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- EUROCAE ED-122/RTCA DO-306, Norma de seguridad y funciones para los servicios de enlace de datos para tránsito aéreo en espacio aéreo oceánico y remoto (*Oceanic SPR Standard*).
- EUROCAE ED-154A/RTCA DO-305A, Norma de interoperabilidad FANS 1/A – red de telecomunicaciones aeronáuticas (FANS 1/A – ATN B1 Interop Standard).

Resumen del módulo

Título del módulo:						
B0-40 TBO: Mayor seguridad operacional y eficiencia mediante la aplicación inicial de servicios de enlace de datos en ruta						
<u>Elementos:</u>		<u>Equipo/Aire</u>		<u>Equipo/Tierra</u>		
1. ADS-C sobre áreas oceánicas y remotas		- FANS 1/A; ATN B1		- ADS-C		
2. CPDLC continental				- VDL Modo 2/ CPDLC continental		
Supervisión de la implantación e impacto en el rendimiento						
<u>Avance en la implementación</u>		Beneficios cualitativos de rendimiento asociados únicamente con cinco principales KPAs				
1. Indicador: <i>Porcentaje de CPDLC implementadas en FIR con áreas oceánicas y remotas</i>		<u>KPA- Acceso/ Equidad</u>	<u>KPA- Capacidad</u>	<u>KPA-Eficiencia</u>	<u>KPA-Medio ambiente</u>	<u>KPA-Seguridad operacional</u>
		No aplicable	Una mejor localización del tráfico y una menor separación permiten aumentar la capacidad. Menor carga de trabajo en las comunicaciones y mejor organización de las tareas de los controladores, aumentando así la capacidad de los sectores	Se puede reducir la separación mínima de las rutas/derrotas y vuelos, permitiendo la aplicación de encaminamientos flexibles y perfiles verticales más cercanos a los preferidos por los usuarios	Menor cantidad de emisiones como resultado de un menor consumo de combustible	Las redes de seguridad basadas en la ADS-C apoyan el monitoreo del cumplimiento con los niveles autorizados, el monitoreo del cumplimiento con las rutas, los avisos de violación de zonas peligrosas y una mejor búsqueda y salvamento. Menores ocurrencias de malos entendidos; solución a situaciones de micrófono trabado (<i>stuck microphone</i>)

APENDICE B

FORMATOS DE OBJETIVO DE PERFORMANCE (ENLACE DE DATOS)

OBJETIVO DE RENDIMIENTO REGIONAL: <u>SAM ATM/06</u> MEJORAR LA CONCIENCIA SITUACIONAL ATM				
Beneficios				
Seguridad Operacional	<ul style="list-style-type: none"> La disponibilidad de datos electrónicos del terreno y los obstáculos en el puesto de pilotaje permite una reducción del número de accidentes CFIT La mejora de la consciencia situacional proporciona datos que facilitan la toma de decisiones operativas, reforzando la seguridad operacional 			
Protección del Medio ambiente y desarrollo sostenible del transporte aéreo	<ul style="list-style-type: none"> Vigilancia de tránsito aéreo mejorada proporciona una reducción en la separación entre aeronaves, permitiendo una mejor afluencia de tránsito aéreo y ampliando la capacidad ATC Contribuye a colaboración entre tripulación de vuelo y el sistema ATM Contribuye en toma de decisiones en colaboración (CDM) a través de la compartición de información de datos aeronáuticos Reducción de la carga de trabajo para pilotos y controladores 			
Métricas				
<ul style="list-style-type: none"> Reducción de accidentes CFIT Reducción del número de errores operacionales, incluyendo los LHD. 				
<i>Estrategia 2012 – 2018</i>				
COMPO- NENTES OC ATM	TAREAS	PERIODO INICIO-FIN	RESPONSABI- LIDAD	SITUACIO N
ATM-SDM AO CM	a) Elaborar un plan de acción para la mejora de la consciencia situacional de pilotos y controladores	(*) - 2012	Proyecto Regional	Válida
	b) implantar sistemas de proceso de datos de plan de vuelo (nuevo formato FPL) y herramientas de comunicación de datos entre ACC	(*) – 2014	Estados	Válida
	c) Implantar tecnologías de vigilancia ATS y sus aplicaciones según sea requerido	2012 – 2018+	Estados	Válida
	d) Implantar sistemas de comunicaciones aire-tierra a través de enlace de datos (ADS-C/CPDLC en espacios aéreos oceánicos, ADS-B, D-ATIS, DCL, D-VOLMET, etc.)	(*) – 2018+	Estados	Válida
	e) implantar herramientas de apoyo avanzadas de automatización para contribuir a la compartición de la información aeronáutica	2015 – 2018+	Estados	Válida
	f) monitorear el desarrollo de la implantación	(*) – 2018+	GREPECAS	Válida
Vínculo con las GPI	GPI/1: uso flexible del espacio aéreo; GPI/6: gestión de afluencia de tránsito aéreo; y GPI/7: gestión dinámica y flexible de rutas ATS; GPI/9: consciencia situacional; GPI/13: diseño y gestión de aeródromos; GPI/14: operaciones en la pista; y GPI/16: apoyo a las decisiones y sistemas de alerta; GPI/17: implantación de aplicaciones de enlace de datos; GPI/18: información aeronáutica; GPI/19: sistemas meteorológicos, GPI/22: Infraestructura de comunicación.			

(*) Indica que la tarea se ha iniciado previamente al plazo considerado para esta planificación.

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OBJETIVO DE RENDIMIENTO REGIONAL: <u>SAM CNS/02</u> SERVICIO MOVIL AERONAUTICO EN LA REGION SAM				
Beneficios				
Seguridad Operacional	<ul style="list-style-type: none"> • Reducción de los errores operacionales en coordinaciones entre ACC Adyacentes haciendo las coordinaciones ATS más eficientes; y • Reducción de la carga de trabajo al piloto y el controlador. 			
Protección del Medio Ambiente y Desarrollo Sostenible del Transporte Aéreo	<ul style="list-style-type: none"> • Aseguramiento de la cobertura y calidad de las comunicaciones en el servicio ATS; • Incremento de la disponibilidad de las comunicaciones para el servicio ATS; • Apoyo al servicio AIM/MET; y • Aseguramiento del espectro de radiofrecuencia para el servicio de comunicación, asignado a la aviación. 			
Métrica				
<ul style="list-style-type: none"> • Porcentaje de cumplimiento de la Tabla FASID 2-A; • Número de sistemas CPDLC implantados; • Número de sistemas DCL implantados; • Número de sistemas D-ATIS implantados; y • Número de sistemas VOLMET implantados. 				
Estrategia 2012 - 2018				
COMPONENTES OC ATM	TAREAS	PERIODO INICIO-FIN	RESPONSABILIDAD	SITUACION
AOM ATM- SDM DCB CM	a) Completar la implantación de los servicios requeridos en la tabla CNS 2-A “Servicio Móvil Aeronáutico SMAS”	(*) - 2014	Estados	Válida
	b) En ruta Continental: Completar cobertura de comunicaciones VHF en espacio aéreo inferior, donde las operaciones así lo requieran.	2012- 2015	Estados	Válida
	c) Implantar el CPDLC área oceánica, manteniendo el servicio HF como respaldo	(*) - 2018	Estados	Válida
	d) Implantar el CPDLC en área continental seleccionada.	2012- 2018	Estados	Válida
	e) Área Terminal: Implantación de canales VHF diferentes para los servicios de torre de control y APP en todos los aeropuertos donde se utiliza un solo canal para atender los servicios de APP y torre de control	(*) - 2015	Estados	Válida
	f) Implantación de servicios DCL en aeródromos seleccionados	2016-2018	Estados	Válida
	g) Implantación de servicios D-ATIS en aeródromos seleccionados	2012-2017	Estados	Válida
	h) Implantación de servicios VOLMET (por voz y por datos)	(*) - 2018	Estados	Válida
	i) Garantizar la protección del espectro de radiofrecuencia utilizados para los servicios de comunicaciones actuales y futuros previstos	(*) -2018	Estados OACI	Válida
	j) Monitorear el avance de la implantación	2012-2018	GREPECAS	Válida
Vínculo con las GPI	GPI/6: ATFM, GPI/9: Conciencia situacional, GPI/17: Aplicaciones de enlaces de datos, GPI/19: Sistemas meteorológicos, GPI/22: Infraestructura de comunicación, GPI 23: Radioespectro aeronáutico			

(*) Indica que la tarea se ha iniciado previamente al plazo considerado para esta planificación.

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OBJETIVO DE RENDIMIENTO REGIONAL : <u>SAM CNS/04</u> SERVICIO DE VIGILANCIA ATS EN LA REGION SAM				
Beneficios				
Seguridad Operacional	<ul style="list-style-type: none"> • Incremento de conciencia situacional ATM; • Mejora en coordinaciones ATS reduciendo errores operacionales en coordinaciones entre ACC adyacentes; y • Reducción de carga de trabajo al piloto y controlador. 			
Protección del Medio Ambiente y Desarrollo Sostenible del Transporte Aéreo	<ul style="list-style-type: none"> • Facilita el suministro ATS; • Aumento de la capacidad del espacio aéreo; • Soporta la implantación del PBN y rutas aleatorias; y • Optimización de recursos al compartir información. 			
Métricas				
<ul style="list-style-type: none"> • Número de sistemas ADS-C en FIR oceánicos implantados; • Número de ACC's adyacentes con intercambio de datos de vigilancia ATS; • Porcentaje de espacio aéreo en ruta para niveles superiores con cobertura ADS-B; y • Número de sistemas A-SMGCS implantados. 				
<i>Estrategia 2012 – 2018</i>				
COMPO- NENTES OC ATM	TAREAS	PERIODO INICIO-FIN	RESPONSABILID AD	SITUACION
AOM AO TS CM ATM-SDM	a) Implantar en áreas de ruta sistemas ADS-B y/o MLAT	2012-2018 +	Estados	Válida
	b) Implantar sistemas de guía y control de movimiento en superficie A-SMGCS en aeropuertos que previo estudio así lo requiera	2013- 2018 +	Estados	Válida
	c) Implantar el servicio ADS-C en todos los Estados con responsabilidad sobre un FIR oceánico	(*) - 2018	Estados	Válida
	d) Implantar el intercambio de datos de vigilancia ATS entre ACCs adyacentes.	(*)- 2018+	Estados	Válida
	e) Garantizar la protección del espectro de radiofrecuencia utilizados para los servicios de comunicaciones actuales y futuros previstos	(*) -2018	Estados OACI	Válida
	f) Monitorear el avance de la implantación	2012-2018	GREPECAS	Válida
Vínculo con las GPI	GPI/5: RNAV y RNP; GPI/6: ATFM; GPI/9: Conciencia situacional; GPI/10: Diseño y gestión del área terminal; GPI/11: SID y STAR con RNP y RNAV; GPI/12: Integración Funcional de Sistemas de Tierra y de a bordo; GPI/13: Diseño y gestión de aeródromos; GPI/14: Operaciones de pista; GPI/17: Aplicaciones de enlaces de datos, GPI/22: Infraestructura de comunicación, GPI/23: Radioespectro aeronáutico			

(*) Indica que la tarea se ha iniciado previamente al plazo considerado para esta planificación.

APENDICE C

FORMATO DE INFORME DE NAVEGACION AEREA (ANRF) – B0-TBO

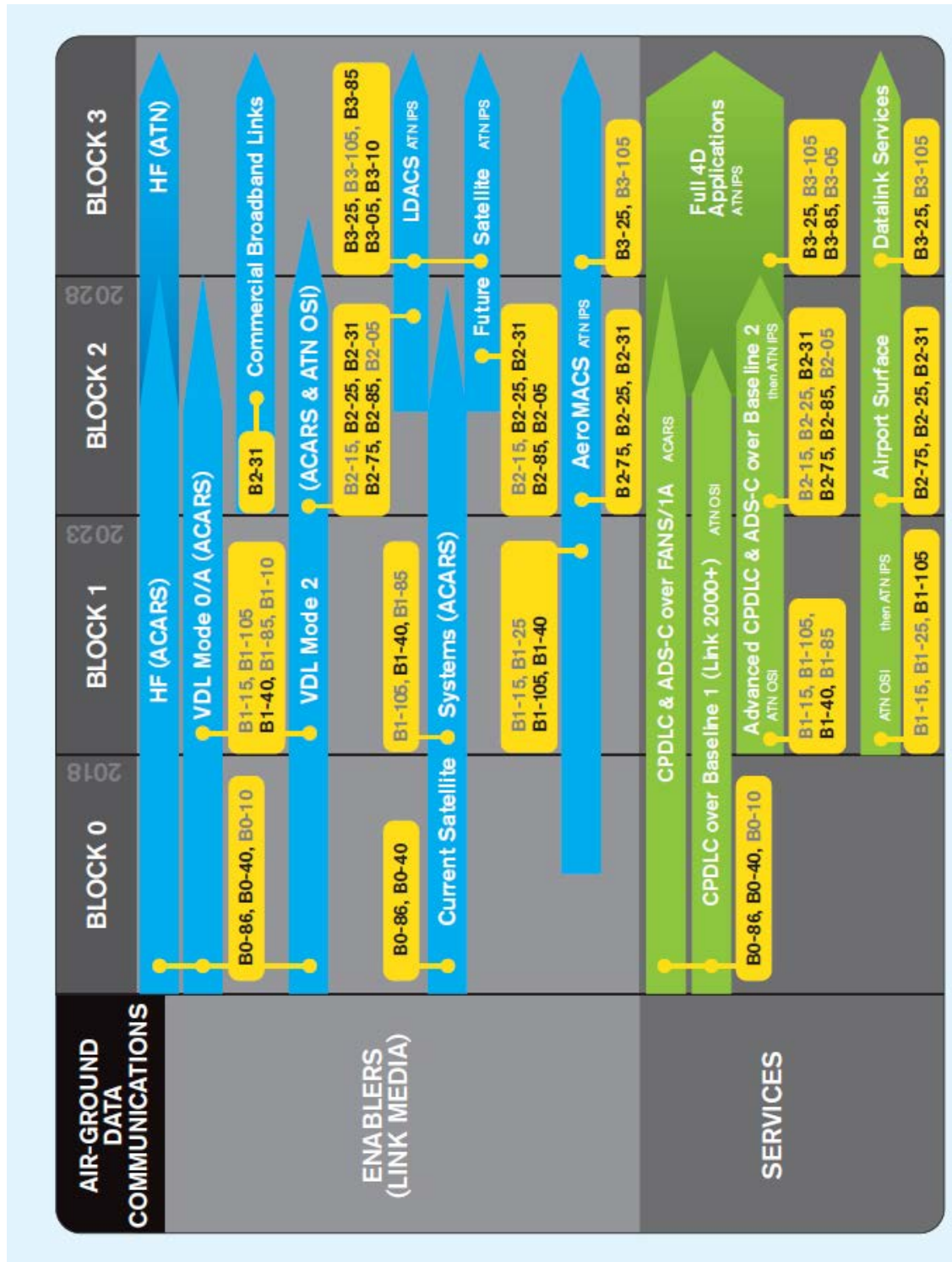
OBJETIVO REGIONAL/NACIONAL DE PERFORMANCE – B0-40: Mayor seguridad operacional y eficiencia mediante la aplicación inicial de servicios en ruta de enlace de datos					
Área 4 de mejoramiento de la eficiencia: Trayectorias de vuelo eficientes mediante operaciones basadas en la trayectoria					
ASBU B0-40: Impacto sobre las principales Áreas Clave de Performance (KPA)					
	Acceso y equidad	Capacidad	Eficiencia	Medio ambiente	Seguridad operacional
Aplicable	N	Y	Y	Y	Y
ASBU B0-40: Avance en la implementación					
Elementos			Estado de implementación (tierra y aire)		
1. ADS-C sobre áreas oceánicas y remotas			Junio 2018 Proveedor de servicios		
2. CPDLC continental			Junio 2018 Proveedor de servicios		
ASBU B0-40: Obstáculos/problemas para la implementación					
Elementos	Área de Implementación				
	Implementación de sistemas terrestres	Implementación de aviónica	Disponibilidad de procedimientos	Aprobaciones operacionales	
1. ADS-C sobre áreas oceánicas y remotas	NIL	La ADS para la aviación general está pendiente de implementación	Los procedimientos GOLD están pendientes de implementación	Falta de inspectores debidamente capacitados para la aprobación de las operaciones	
2. CPDLC continental	NIL	CPDLC para la aviación general está pendiente de implementación	Los procedimientos GOLD están pendientes de implementación	Falta de inspectores debidamente capacitados para la aprobación de las operaciones	
ASBU B0-40: Monitoreo y medición de la performance (Implementación)					
Elementos		Indicadores de performance/Métricas de apoyo			
1. ADS-C sobre áreas oceánicas y remotas		Indicadores: Porcentaje de FIR en las que se ha implementado la ADS C Métrica de apoyo: Cantidad de procedimientos ADS C sobre áreas oceánicas y remotas aprobadas			
2. CPDLC continental		Indicadores: Porcentaje de CPDLC implementadas en FIR con áreas oceánicas y remotas Métrica de apoyo: Cantidad de procedimientos CPDLC sobre áreas oceánicas y remotas aprobados.			

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ASBU B0-40: Monitoreo y medición de la performance (Beneficios)	
Áreas clave de performance	Beneficios
Acceso y equidad	NA
Capacidad	Una mejor localización del tráfico y una menor separación permiten aumentar la capacidad. Menor carga de trabajo en las comunicaciones y mejor organización de las tareas de los controladores, aumentando así la capacidad de los sectores.
Eficiencia	Se puede reducir la separación mínima de las rutas/derrotas y vuelos, permitiendo la aplicación de encaminamientos flexibles y perfiles verticales más cercanos a los preferidos por los usuarios
Medio ambiente	Menor cantidad de emisiones como resultado de un menor consumo de combustible
Seguridad operacional	Las redes de seguridad basadas en la ADS-C apoyan el monitoreo del cumplimiento con los niveles autorizados, el monitoreo del cumplimiento con las rutas, los avisos de violación de zonas peligrosas y una mejor búsqueda y salvamento. Menores ocurrencias de malos entendidos; solución a situaciones de micrófono trabado (<i>stuck microphone</i>).

APENDICE D

HOJA DE RUTA DE COMUNICACIONES ASBU



APENDICE E**CÁLCULO DE DISPONIBILIDAD DE SISTEMAS****E1- INTRODUCCIÓN**

Probabilidades son números asociados a eventos que indican lo cuanto es probable que ocurra un evento cuando un experimento es realizado. Una ley de probabilidad es una función que asocia un número a un evento. Sea E un experimento aleatorio con espacio muestral S. Una ley de probabilidad para el experimento E es una regla que asocia a cada evento A un número $P(a)$ llamado de probabilidad de A.

La disponibilidad de un sistema es hecha a partir del modelaje matemático con la interconexión de elementos en serie y en paralelo de todos los vínculos (eslabones) componentes de dicho sistema. Para la definición si dos elementos deben ser combinados en serie o en paralelo, operando dos a dos, se admiten las siguientes reglas:

- Los elementos son considerados operando en serie si la falla de cualquier de ellos resulta la indisponibilidad de la combinación;
- Al revés, son considerados operando en paralelo cuando la combinación de los dos vínculos solamente queda inoperante por la falla de ambos.

E2- DISPONIBILIDAD DE UNA COMBINACION EN SERIE

La Figura E-1 representa dos elementos que están ligados en serie. Debe tomarse en cuenta que es solamente un ejemplo de un circuito que puede tener muchos vínculos dos a dos que estén configurados en serie.



Figura E1: Combinación de dos Elementos en Serie

En la introducción se refleja que un sistema que posee elementos en serie debe considerar que falla si uno de los elementos sufre una paralización. Considerando $P(A) = d_A$ como la probabilidad de funcionamiento del elemento A y $P(B) = d_B$ como la probabilidad del elemento B y $P(eq) = d(eq)$ como el resultado equivalente del sistema se tiene:

$$P(eq) = P(A) * P(B) = d_A * d_B \quad (E-1)$$

E3- DISPONIBILIDAD DE UNA COMBINACION EN PARALELO

La Figura E-2 representa dos elementos que están ligados en paralelo.

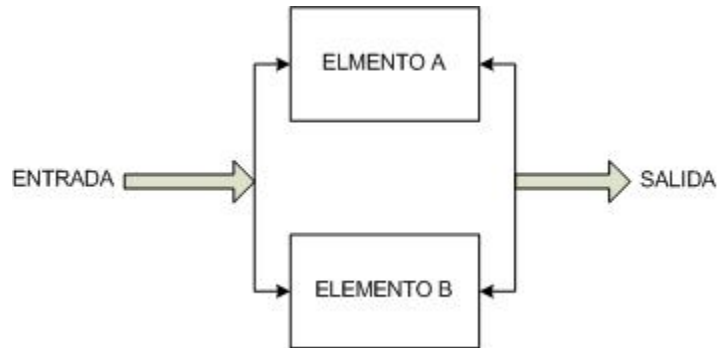


Figura E2: Combinación de dos Elementos en Paralelo

La regla presentada en la introducción de este apéndice explicita que el sistema está en funcionamiento si por lo menos uno de los dos elementos está en operación normal.

Para la asociación en paralelo se aplica el corolario de probabilidad:

$$P(A \cup B) = P(A) + P(B) - P(A \cap B) \quad \forall \forall \quad (E-2)$$

Considerando $P(A)=d_A$ como la probabilidad de funcionamiento del elemento A y $P(B)=d_B$ como la probabilidad del elemento B y $P(eq)$ como el resultado equivalente del sistema se tiene y teniéndose en cuenta E-2 :

$$d_{eq} = d_a + d_b - d_a * d_b \quad (E-3)$$

APENDICE F**PUNTOS PRINCIPALES DEL PROYECTO PARA LA CONCESION DE LA RED DE ENLACE DE DATOS EN BRASIL****1. Objeto**

1.1 La CONCESION del derecho de prestación de servicio público, incluyendo la implantación de infraestructura, en la categoría del Servicio Móvil Aeronáutico, para la provisión de la capacidad de cambio de mensajes entre aeronaves e usuarios en suelo, en el espacio aéreo bajo la jurisdicción brasileña. Esta capacidad (denominada Servicio de “Data Link”) podrá ser ofertada por la CONCESIONARIA a empresas aéreas (denominadas “Usuarios Privados”) para cambio de mensajes entre aeronaves e sus operadoras.

2. Puntos básicos

2.1 La explotación de la concesión en base a la infraestructura instalada es por un periodo de 20 años prorrogable por igual periodo.

2.2 Para que se garantice el intercambio de mensajes ATS, la Concesionaria tiene que practicar el *internetworking* con otros posibles Proveedores de Servicio de Data-link con cobertura internacional.

Nota: Párrafo importante porque no hay *internetworking* entre proveedores para efectos de mensajes AOC y AAC.

2.3 La Concesionaria debe propiciar a la Concedente la capacidad de intercambio de mensajes por medio de enlaces de datos pro medio de ACARS, AOA y ATN/VDL *Mode 2* en regiones continentales y SATCOM en región oceánica.

Nota: Para efectos de SATCOM las empresas aéreas pagan por todos los servicios a la Concesionaria, cualquier que sea la clase de mensajes (AAC, AOC y ATS) ya que la Concesionaria tiene que hacer los pagos al Proveedor de Segmento Espacial (INMARSAT).

2.4 Los componentes esenciales de la infraestructura a ser implementada, operada y mantenida por la CONCESSIONARIA son:

- Estaciones Remotas de comunicación radio que ofrezcan la cobertura prevista en el Proyecto Básico.
- Un Sistema enrutador de mensajes denominado Procesador “Data Link” (e/o enrutador ATN, cuando implantado), instalado en Brasil, e interconexiones de ese Sistema con las estaciones remotas de comunicación radio.
- Interconexiones entre el Procesador “Data Link” y otros sistemas de proveedores de servicios “Data Link”, para fines ATS.
- Interconexiones entre el Procesador “Data Link” y sistemas automatizados de Usuarios Privados e de la CONCEDENTE.

Notas:

(i) *Las estaciones remotas de comunicación radio deben tener la siguiente configuración de frecuencias:*

- f_{acars} - ACARS (Enlace ACARS)
 - f_{vdl-2} - ACARS Over AVLC - AOA (Enlace VDL-2)
ATN (cuando implantada)
- (ii) La capacidad de comunicación en región oceánica, aunque no sea objeto del contrato, debe ser provista por la CONCESIONARIA, en complemento a la cobertura de las estaciones remotas de comunicación radio, por medio de cobertura SATCOM subcontratada por la CONCESIONARIA, de forma que no sea necesaria la implementación de estación terrena SATCOM para provisión de esa capacidad en Brasil
- (iii) El Procesador “Data Link” o el futuro enrutador ATN deberá estar disponible, por lo menos, 99,996% del tiempo, en una base mensual, considerando inclusive la disponibilidad de la energía que lo alimenta. Además de eso, deberá operar de forma totalmente independiente de cualesquiera otros sistemas enrutadores de mensajes externos, mismo que de la CONCESIONARIA, o sea, deberá ser un sistema totalmente autónomo en términos funcionales.

2.5 La implantación de la infraestructura de comunicaciones “data link” air-tierra (Estaciones Remotas de radiocomunicaciones y sistema enrutador de mensajes) deberá soportar el tráfico de mensajes de interés de DECEA para la prestación de los servicios ATS, y el tráfico de mensajes de interés de operadoras de aeronaves contratantes del servicio de intercambio de mensajes junto a la operadora de la infraestructura, con aeronaves debidamente equipadas, dentro de la cobertura de radiocomunicaciones del sistema.

2.6 El tráfico “UPLINK” y “DOWNLINK” de mensajes ATS procesadas por el Servicio “DATA LINK” de la CONCESIONARIA y el encaminamiento de los mensajes ATS para las dependencias operacionales en territorio brasileño no deberán ser tarifados por la CONCESIONARIA.

2.7 El tráfico “UPLINK” y “DOWNLINK” de mensajes ATS originadas o destinadas a las dependencias operacionales en territorio brasileño deberá ser disponibilizado para todos los Usuarios Privados, sin tarificación, en el área de jurisdicción aeronáutica brasileña.

3. Arquitectura básica

3.1 La arquitectura del SISTEMA “DATA LINK”, con referencias de las interfaces especificadas es presentada en la Figura E1.

Notas:

- (i) Son componentes del SISTEMA “DATA LINK”
- Estaciones remotas de comunicaciones radio que ofrezcan la cobertura prevista el Proyecto Básico.
 - Un sistema enrutador de mensajes (denominado Procesador “Data Link”) e interconexiones de ese sistema con las estaciones remotas de comunicación radio.
 - Interconexiones entre el Procesador “Data Link” y sistemas enrutadores de mensajes extranjeros para fines ATS.
 - Interconexiones entre el Procesador “Data Link” y sistemas usuarios de la CONCEDENTE, por medio de red IP;
 - Puntos de acceso de la red de la CONCEDENTE (en Rio de Janeiro y en Brasilia) a la red de la CONCESIONARIA, y a la estructura de gestión de movilidad y de seguridad asociados.
- (ii) Son interfaces del sistema:
- aquellas rotuladas en la figura como “A”, “B”, “C” e “D”.

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- interconexiones con sistemas enrutadores de mensajes extranjeros para fines ATS..
 - interconexiones con sistemas automatizados de USUARIOS PRIVADOS.
- (iii) Las frecuencias de las estaciones remotas destinadas a las comunicaciones ACARS deben estar conectadas al Procesador “Data Link” (interfaces “B”).
- (iv) Frecuencias destinadas a comunicaciones ATN deben ser disponibilizadas en los puntos de acceso de Brasília y Rio de Janeiro (interfaces “D”) a partir del futuro enrutador ATN (“interface B”).
- (v) Mensajes provenientes y destinadas a aeronaves en región oceánica deben ser transmitidas para el proveedor de comunicaciones SATCOM por medio de la interconexión del Procesador “Data Link” de la CONCESSIONÁRIA con otros sistemas enrutadores de mensajes.
- (vi) El SISTEMA “DATA LINK” deberá ser implantado con productos tipo COTS, salvo cuando comprobadamente inviable técnicamente.
- (vii) Las interconexiones entre las estaciones remotas y el Procesador “data link” y entre estaciones y los puntos de acceso de Brasília y Rio de Janeiro son parte del SISTEMA “DATA LINK” y deben ser disponibilizadas por la CONCESIONARIA, por medio de red IP.

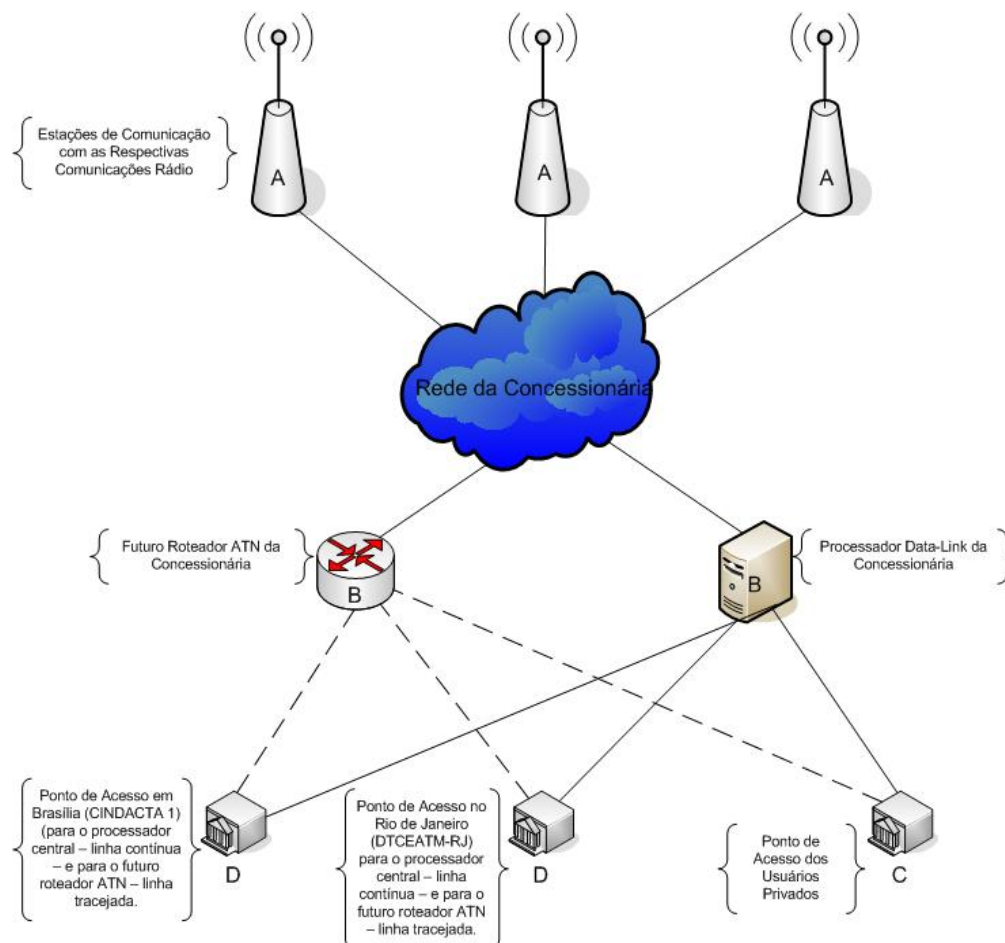


Figura E1: Arquitectura Básica de la Concesión

Nota: Por razones operacionales, el punto de acceso de Brasilia fue cambiado para Recife, donde está implantado el ACC-AO que provee, actualmente, las funcionalidades de CPDLC y ADS-C en el área oceánica.

APENDICE G

SATCOM

G1- INTRODUCCIÓN

Para las transmisiones de datos aire-tierra en áreas oceánicas o continentales remotas es posible la utilización de la tecnología de transmisión por satélite y las principales constelaciones de satélites, y que pueden ser utilizados por los Estados de la Región SAM, son pertenecientes a las empresas INMARSAT y IRIDIUM.

El nombre común que se da para la referida forma de comunicaciones es SATCOM. En las próximas secciones de este apéndice serán dadas las características básicas de los sistemas de los proveedores.

Debe ser notado que los Estados/ANSP no contratan directamente segmento espacial de INMARSAT y IRIDIUM, lo que es hecho por proveedores de servicios (DSP), cuyos los principales son las empresas SITA y ARINC. En conclusión, los estados contratan servicios del DSP que, por su vez, contratan segmento espacial de INMARSAT y IRIDIUM.

G2 – IRIDIUM

El sistema de comunicaciones por satélite IRIDIUM fue primeramente concebido para poseer 77 satélites, lo que corresponde al número atómico del elemento Iridio. Sin embargo, fue puesto en órbita en el año de 1998 y la constelación comprende un conjunto de 66 satélites de órbita baja – *Low Earth Orbit* (LEO). Cuando fue diseñado, el sistema sería para ser utilizado para las comunicaciones de telefonía móvil, pero se vislumbró la posibilidad de utilización de la constelación para uso de datos y voz para las comunicaciones aire-tierra entre aeronaves, centros de control de tránsito aéreo y empresas aéreas.

El sistema también contempla una red terrestre de modo que las informaciones recibidas en tierra puedan ser enrutadas para cualquier lugar del globo terrestre.

La constelación del IRIDIUM, ilustrada en la Figura G1 está distribuida a lo largo de seis planes orbitales cada uno conteniendo once satélites LEO. La cobertura provista es global, incluyendo los polos, con la mayor eficiencia en relación al número de satélites. El sistema asegura que cada región en la Tierra sea cubierta, por lo menos, por un satélite en cualquier momento.

En adición a los satélites operacionales, hay algunos que están en órbita y que pueden ser maniobrados para que asuman la posición de algún satélite que tenga sufrido una falla. Los satélites están en una órbita con altura aproximada de 420 NM, y completan una órbita alrededor del globo a cada, aproximadamente, 100 minutos a una velocidad de 14.630 NM/h.

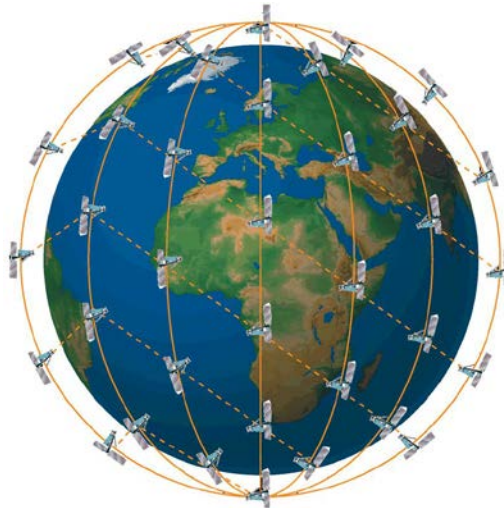


Figura G1- Ilustración de Constelación IRIDIUM

La utilización de la constelación IRIDIUM para fines de comunicaciones aire-tierra toma una considerable importancia en las localidades remotas o en lugares en que no es practicable la instalación de equipos VHF.

Los aviónicos comprenden un *Satellite Data Unit (SDU)*, que está ligado al ACARS MU, y una pequeña antena de bajo ganado que es instalada en el fuselaje del avión. De ese modo, los operadores de las aeronaves disfrutan de la ventaja de tener equipos instalados con bajo peso y con la eficiencia de la garantía de las comunicaciones en ámbito global para las transmisiones de los mensajes AAC, AOC y servicios de comunicaciones por voz.

En términos de aplicaciones con fines ATS, la OACI, después de evaluar detenidamente todas las características técnicas, incorporó el uso del IRIDIUM en las provisiones concernientes al Servicio Móvil Aeronáutico (En Ruta) por Satélite – *Aeronautical Mobile Satellite (Route) Service – AMS(R)S* para las aplicaciones FANS 1A con el uso de plataforma ACARS.

G3 – INMARSAT

El Sistema INMARSAT es basado en una constelación de Satélites Geoestacionarios (GEO). Hay tres clases de satélites en uso:

- a) Inmarsat-2: que provee solamente foco global en Banda L y es, generalmente, usado para servicios legados;
- b) Inmarsat-3: provee foco global y regional en algunas áreas específicas del globo terrestre y es compuesto de cinco satélites;
- c) Inmarsat-4: provee foco global, regional además de foco estrecho y estos últimos posibilitan la utilización en el *Broadband Global Area Network (BGAN)*.

El Inmarsat-3 provee los servicios para una determinada capacidad llamada de “Classic Aero” y es el conjunto de satélites que está homologado para el uso en aplicaciones ATS/ACARS con conmutación por circuitos y paquetes.

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En las últimas reuniones del ACP, fueron presentados nuevos conceptos que garantizan los rigurosos requisitos de disponibilidad previstos en documento GOLD para RSP y RCP para garantizar las separaciones previstas.

Desde el año de 2007, el INMARSAT tiene un servicio, llamado de SwiftBroadband, que deberá reemplazar el Classic Aero en los próximos años. La alta capacidad de transmisión de datos podrá, inclusive, ser la base para la aplicación de ATN con el uso de satélites.

Para garantizar la disponibilidad más exigente del documento GOLD, el Swiftbroadband utiliza los satélites Inmarsat-4 y *Inmarsat's Broadband Global Area Network (BGAN)*. Un diagrama que representa el SwiftBroadband es dado en la Figura G2, donde se nota, claramente, la redundancia de satélites para garantizar la confiabilidad de los servicios.

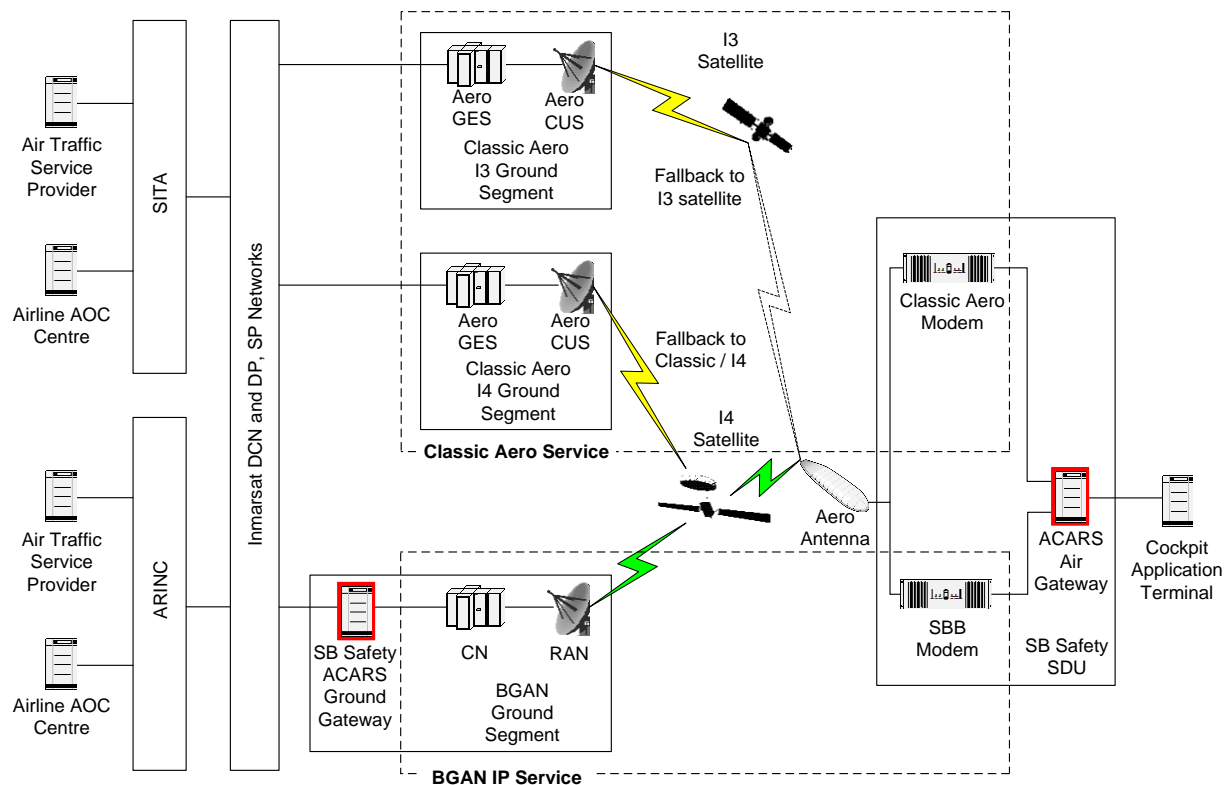



Figura G2: Arquitectura Básica del SwiftBroadband

APPENDIX E / APENDICE E

	INTERNATIONAL CIVIL AVIATION ORGANIZATION TECHNICAL CO-OPERATION BUREAU TECHNICAL SPECIFICATION	THIS COLUMN TO BE COMPLETED BY TENDERER COMPLIANCE STATEMENT Tenderer must state below, against every item, <i>Compliance</i> or <i>Non Compliance</i> . Failure to complete and return this form may invalidate the bid.
ICAO SPECIFICATION CODE: 94-03-550 RLA/06/901 PR 21101102 24 MAY 2013		
TITLE: SAM REGIONAL RAIM PREDICTION AVAILABILITY SERVICE VIA WEB		
<i>It is strictly prohibited for tenderers to alter this document. Only the originator of the specification may provide amendments.</i>		SUPPLIER NAME:
SECTION A – INTENT AND STANDARDS		
<p>1. OBJECTIVE</p> <p>1.1 The International Civil Aviation Organization (ICAO), on behalf of the Governments of Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, French Guiana (France), Guyana, Paraguay, Peru, Panama, Suriname, Uruguay and Venezuela <i>intends to procure, on a turnkey basis, the implementation of a SAM Regional RAIM (Receiver Autonomous Integrity Monitoring) prediction availability service for an initial period of four (4) years through a WEB page functioning the 24 hour per seven day a week (24/7) to support the PBN procedures en route, terminal and approach area.</i></p> <p>2. OBJECTIVE OF SAM REGIONAL RAIM PREDICTION AVAILABILITY SERVICE (SRRPAS)</p> <p>2.1 In order to achieve this objective, the aeronautical authorities of the Region have agreed that the SRRPAS shall ensure:</p> <p>2.1.1 To provide users of an on-line status of the prediction availability of GPS RAIM the 24 hours/7 days a week (24/7) to support the PBN RNAV/RNP operations at Regional level and to each State of the SAM Region.</p> <p>2.1.2 To develop a web site for the SRRPAS.</p> <p>2.1.3 To be easily expandable to cover the availability of the RAIM prediction service in other constellations of satellite navigation systems (GALILEO, GLONASS, Beidou).</p> <p>2.1.4 To cover all regional airspace for RNAV/RNP operations for both Fault Detection (FD) and Fault Detection and Exclusion (FDE) capable receivers.</p>		

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TITLE: SAM REGIONAL RAIM PREDICTION AVAILABILITY SERVICE VIA WEB	COMPLIANCE STATEMENT

SECTION A – INTENT AND STANDARDS	
<p>3. SCOPE</p> <p>3.1 The Project contemplates that the Successful Bidder shall provide:</p> <p>a) SAM Regional RAIM Prediction Availability Service (FD and FDE capable receivers) for the following PBN/RNAV /RNP operations</p> <p style="padding-left: 20px;">En route Oceanic and remote continental area: RNP 10, RNP 4, RNP 2, Advanced RNP Continental area: RNAV 5, RNAV 2, RNAV 1, RNP 2, Advanced RNP, RNP 0.3</p> <p style="padding-left: 20px;">Terminal RNAV 5, RNAV 2, RNAV 1, RNP 1, Advanced RNP, RNP 0.3</p> <p style="padding-left: 20px;">Approach RNAV 1 (Initial, intermediate, missed approach segments) RNP 1 (Initial, intermediate, missed approach segments) RNP 0.3 (Initial, intermediate, missed approach segments) Advanced RNP (all segments) RNP APCH (all segments) RNP AR APCH (Optional) Departure RNAV 2, RNAV 1, RNP 1, Advanced RNP, RNP 0.3</p> <p>b) Provision of database of waypoints within SAM airspace SRRPAS website design.</p> <p>c) The develop of a WEB page for he SRRPAS</p> <p>d) To maintain and manage the WEB page for the SRRPAS</p> <p>e) The SRRPAS application shall be hosted on an dual application server with a database back- end providing highly available file storage facilities</p> <p>4. BASIC TECHNICAL CHARACTERISTICS</p> <p>4.1 The hardware shall consist of two servers, one for the redundant primary and mirror (2 in total) See Figure 1 for SRRPAS architecture:</p>	

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SECTION A – INTENT AND STANDARDS

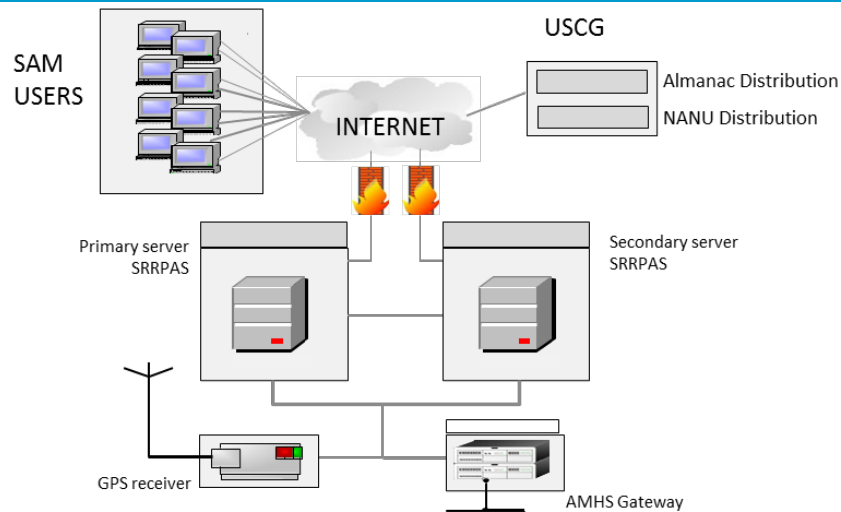


Figure 1 SRRPAS Architecture

5. GENERAL CONSIDERATIONS

- 5.1 The Successful Bidder shall be responsible for the implementation of a SRRPAS, a design of a WEB page, acquisition, installation, hosting and commissioning of the required equipment and services, with all the accessories and facilities and to maintain and manage the SRRPAS.
- 5.2 The system shall be installed, hosted and operated on the place of the bid winner installation and deployed across two geographically dispersed servers, at two different Data Centres, offering 24/7 service with a 99.5% availability.

6. RULES AND STANDARDS

- 6.1 All designs, materials, manufacturing techniques and workmanship shall be in accordance with the highest accepted international standards.
- 6.2 Where applicable, the system shall fully comply with or exceed the requirements of the following documents (latest edition plus any related amendments):
- a) the standards and recommended practices of the International Civil Aviation Organization (ICAO) contained in the Annexes, as well as the provisions of its manuals, documents and circulars concerning aeronautical telecommunications, the ATN, CNS/ATM systems, and air traffic services. The Successful Bidder is responsible for complying also with the new standards, amendments and

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SECTION A – INTENT AND STANDARDS	
<p>recommendations issued during the implementation of the project;</p> <p>b) those applied by public carriers in each State; and</p> <p>c) the ISO 9000 certification in terms of its methods and lines of production.</p> <p>6.3 If at the time of the publication of this document the specific rules and standards mentioned in any of the other Sections have been revoked, superseded or updated, the new rules or standards shall be deemed as applicable.</p> <p>7. ALTERNATIVES</p> <p>7.1 Bidders are invited to bid for any alternative that, in their opinion, meets, or exceeds the requirements of, this specification. Any such alternative or variation shall be fully and clearly defined and substantiated so as to easily determine such equivalence or superiority.</p> <p>8. BIDDER'S EXPERIENCE</p> <p>8.1 The Bidder shall demonstrate broad experience in the RAIM Prediction Availability Service implementation The Bidder shall include a list of customers to whom it has supplied the same service during the last five (5) years. The list shall contain the names, addresses and references of customers that can be contacted.</p> <p>8.2 The Bidder shall submit at least three (3) letters of reference with the contact names of different customers with similar projects in different locations to enable verification of the level of compliance of the services previously provided. ICAO or the AAA may contact such customers to check the accuracy of the information submitted.</p> <p>8.3 The Bidder shall demonstrate that the level of quality of its personnel is commensurate to the service to be supplied, presenting also, the certification of each specialist to enable him for each task to be developed to provide the service in this specification.</p> <p>8.4 The service provider shall be a leading company worldwide, with an experience proven and recognised in the international markets.</p> <p>9. BIDDER'S DOCUMENTATION</p> <p>9.1 <i>Statement of compliance: all bids shall be accompanied by a Statement of Compliance, in the form of a copy of the specifications, indicating in the right column whether it Complies (C) or Does not Comply (NC). If the bid states that it complies, any reference,</i></p>	

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<p><i>indication, comment or subsequent note to the contrary shall not release the Bidder from the responsibility for the compliance stated.</i> The Bidder shall make reference to the statement of compliance, indicating what section of its documentation substantiates such statement. Failure to provide such definitive indication with respect to any requirement can invalidate its bid.</p> <p>9.2 The Bidder shall submit its bid in Spanish and English, in two (2) hard copies and one (1) electronic copy. See Section D, Technical Documentation for further details. The official language of the tender will be English.</p> <p>9.3 Each Bidder shall submit the appropriate technical documentation containing data sheets, performance data, drawings, illustrations, pictures, etc., of the system being offered to enable full and detailed assessment of the bidder as a whole, in accordance with that stated in Section C. The financial bid shall provide detailed costs of the services required in this technical specification.</p> <p>9.4 The proposal shall include documentation on operational <i>commands, and other information that the Bidder may deem</i> appropriate.</p> <p>9.5 The Bidder shall submit, together with its bid, a timetable of major activities to be carried out concerning the design, manufacturing, provision, Inspection, installation, and commissioning (see other details in Section E).</p> <p>9.6 Additionally, the Bidder shall submit the available operational manuals (as described in Section D) as part of the proposal.</p>	

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SECTION B – GENERAL REQUIREMENTS	
<p>1. REQUIREMENTS</p> <p>1.1 General guidelines</p> <p>1.1.1 The Bidder shall provide the organizational chart of the company and resumes of its technical staff involved in the tasks provided for in the provision of the services (management and technical).</p> <p>1.1.2 The Bidder shall prepare a project timetable for the implementation of the SRRPA</p> <p>1.1.3 The Successful Bidder shall be fully responsible for the design, selection of components and materials, and installation techniques, to ensure total integration and full compatibility between the main components and all auxiliary units.</p> <p>1.1.4 Within forty-five (45) days following the signing of the contract, the Successful Bidder shall submit for the approval of ICAO a detailed System Design Document (SDD) for the implementation of the SRPP</p> <p>1.1.5 The Successful Bidder shall appoint properly qualified personnel in sufficient number to perform the work within the proposed timeframes.</p> <p>1.1.6 The Successful Bidder shall prepare and submit Inspection tests for approval, and shall conduct the performance tests.</p> <p>1.1.7 The Successful Bidder shall prepare and submit the Final Acceptance Test (PSAT) protocols for approval.</p> <p>1.1.8 The Successful Bidder shall be responsible for host maintain and manage the SRRAPS</p> <p>1.1.9 The Successful Bidder shall submit the operation manual.</p> <p>1.2 Bidder’s responsibilities</p> <p>1.2.1 The Bidder shall assume full responsibility for the following issues:</p> <p>a) Project proposal, organisation and distribution of all works.</p> <p>b) Any deviation from the specifications must be corrected at its own expense.</p>	

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SECTION C – TECHNICAL REQUIREMENTS	
<p>1. INTRODUCTION</p> <p>1.1 SRRPS OVERVIEW</p> <p>General Features</p> <p>1.1.1 SRRPAS will be developed such that User can access up to date information about the GPS Satellite constellation and calculated RAIM unavailability pertinent to their operations.</p> <p>1.1.2 SRRPAS shall make information available to Users over the Internet and shall ensure that the most up to date GPS Satellite constellation data available is used as the basis for RAIM calculations and constellation status reports. The System will use a variety of information sources to collate the best available GPS constellation data. Information shall be made available both graphically and in a textual form.</p> <p>1.1.3 SRRPAS shall be configured such that it is resilient and will provide 99.5% availability. The System shall be deployed in a mirrored configuration with two independent and geographically distributed server installations. The two server installations shall be synchronised to ensure that continuity is preserved regardless of the server used by the User. The SRRPAS software will be designed such that the switch between the primary site and the mirror site in the event of a failure occurs automatically, without human input.</p> <p>1.1.4 SRRPAS shall ensure that the User is made aware of the provenance and source of the constellation data used by the tools. The System will ensure that the Tools use a consistent constellation data set by means of the Constellation Mediator system function.</p> <p>1.1.5 The System shall maintain calculation audit logs that capture the following information:</p> <p>Calculation parameters and results. Data and time of the calculation.</p> <p>1.1.6 In addition the System shall ensure that data provided to Users is logged for audit purposes. At a minimum, the system will record sufficient information to allow the User to be identified and for the information provided to the User to be recreated.</p> <p>1.1.7 The System shall be designed to enable it to be easily expanded to provide an integrity prediction capability for Galileo, GLONASS,</p>	

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<p>Beidou and future navigation systems.</p> <p>2. GPS RAIM PREDICTION SERVICE TECHNICAL APPROACH</p> <p>2.1 SRRPAS shall be a web-based tool with access for SAM regional customers. The information in the web site must be presented in English, Spanish and Portuguese. The main URL and mirror URL shall be defined in conjunction with ICAO on behalf of the SAM States.</p> <p>2.2 The following sections define the proposed tools and functions within SRRPAS.</p> <p>2.2.1 GPS Status Tool</p> <p>2.2.1.1 The GPS Status Tool shall allow the view of the GPS Satellite constellation based on the latest almanac and NANUs (Notice Advisory to Navigation Users) issued by the US Coast Guard.</p> <p>2.2.1.2 The GPS Status Tool shall present the number of operational satellites in the GPS constellation based on the information current at the time of the request to inform users whether or not there are sufficient satellites to meet the minimum requirements for PBN/RNAV/RNP operations shown in Section A, paragraph 3.1 a). Also the almanac used and NANUs that may affect the satellite availability during the period of time requested, shall be displayed.</p> <p>2.2.1.3 The GPS Status Tool shall be configured to provide the status of the GPS constellation for a 72 hour period calculated from the midnight previous to the time at which the status request was made (times are in UTC).</p> <p>2.2.2 Terminal/Approach Tool</p> <p>2.2.2.1 The Terminal/Approach Tool shall use algorithms to calculate the predicted RAIM availability for a 72 hour period for specific Aerodromes. The algorithms shall be used in Terminal mode addressing the RAIM requirements for GNSS receivers operating in Terminal operations ($\pm 1\text{NM}$) in Approach mode addressing the RAIM requirements for GNSS receivers operating in Approach operations ($\pm 0.3\text{NM}$), and RNP AR APCH (optional). Both the Fault Detection (FD) and Fault Detection and Exclusion (FDE) algorithms should be provided, with FD set as the default.</p>	

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<p>2.2.2.2 The Terminal/Approach Tool shall provide a graphical output and a tabular output each of which shall display the predicted RAIM outages over the scenario period for each of the selected aerodromes.</p> <p>2.2.2.3 The Terminal/Approach Tool shall be configured to return the status of the GPS constellation for a 72 hour period calculated from the midnight previous to the time at which the status request was made (times are in UTC).</p> <p>2.2.2.4 The Terminal/Approach Tool should allow up to 10 aerodromes to be specified. Aerodromes are selected by entering their ICAO identifier.</p> <p>2.2.2.5 The Terminal/Approach Tool shall calculate the predicted RAIM availability at the Aerodrome Reference Point (ARP) for baro (pressure altitude) aided and non-baro aided GNSS user equipment at 1 minute intervals throughout the scenario time. The sample time is taken to be the mid-point of a 1 minute period. Therefore a RAIM outage detected at a single sample time will have a duration of 1 minute starting 30 seconds prior to the sample time and ending 30 seconds after the sample time.</p> <p>2.2.3 Visibility Tool</p> <p>2.2.3.1 The SRRPAS has to calculate the location of the GPS satellites relative to a fixed receiver position for a given time duration.</p> <p>2.2.3.2 The Visibility Tool shall provide the following output options:</p> <ol style="list-style-type: none"> a) Graphical sky plot representation of the visible satellites. b) Tabular representation of the visible satellites. (A table of azimuth and elevation values and the visibility status for each satellite at each sample time in the scenario is displayed, azimuth and elevation are displayed in decimal degrees, all satellites shall be included regardless of visibility and “health”. c) Visibility Tool shall require user-configurable parameters as inputs, like: <ul style="list-style-type: none"> - Receiver Position - Mask angle - Scenario duration - Number of samples required to calculate the satellite visibility - UTC date and time - Etc. 	

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<p>2.2.4 Route Tool</p> <p>2.2.4.1 The Route Tool shall calculate the predicted RAIM availability for points along a defined route using either the RAIM algorithm in En-Route mode or the Terminal mode.</p> <p>2.2.4.2 A route shall be defined by a series of waypoints selected, or input, by the user. The tool shall maintain a list of current en-route waypoints and nav aids in the South American Region area which shall be selected by ICAO identifier. The tool shall provide to the user the possibility to define custom waypoints by entering an identifier, State, latitude and longitude</p> <p>2.2.4.3 The system must contain a database of waypoints inside South American Region airspace and easily configured by the user.</p> <p>2.2.4.4 The defined route and the results of the RAIM check shall be able to be saved and to be reviewed for the session.</p> <p>2.2.4.5 The User has the capability to select other angles.</p> <p>2.2.4.6 Both the Fault Detection (FD) and Fault Detection and Exclusion (FDE) algorithms shall be provided.</p> <p>2.2.4.7 The tool has to calculate the anticipated RAIM availability for points spaced at one minute intervals along the route, based upon the Time Offset values entered, and displays any anticipated RAIM outages that equal or exceed 5 minutes (User configurable).</p> <p>2.2.4.8 The Route Tool has to provide a graphical output and a tabular output each displaying the predicted RAIM outages over the scenario period. Both displays have also to show the anticipated outages if the start time is delayed, or brought forward, by 5, 10 or 15 minutes.</p> <p>3. SRRPAS HOSTING AND OPERATIONAL FACTORS</p> <p>3.1 SRRPAS shall be managed and operated by the successful bidder and shall be deployed across two geographically dispersed servers, at two different Data Centres, offering 24/7 service with a minimum availability of 99.5%. (See Figure 1 for SRRPAS architecture).</p> <p>3.2 SRRPAS application shall be hosted on an application server with a database back- end providing highly available file storage facilities.</p>	

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3.3	The server shall be fault-tolerant and shall include support for hot-swapping of essential hardware such as disks and power supplies.
3.4	The hardware shall consist of two servers, one for the redundant primary and mirror (2 in total) with the following minimum specification: <ul style="list-style-type: none"> a) Redundant Pair of firewalling Devices. b) Redundant Pair of Hardware Load Balancers balancing traffic at layer 4, 100Mbit access switch ports with 1Gbps trunks between distribution, aggregation and core switching layers. c) Multiple upstream internet providers shall be provided. d) Servers provided with the following minimum configuration that will be update during the implementation planning phase of the project (Processor (Quad 2.0Ghz) – 4Gb Ram – 2x 72Gb SAS 10k Disks in Raid 1).
3.5	IP security
3.5.1	SRRPAS server infrastructure shall be protected by a dual firewall system. The internal network clusters shall be hosted on a private network segment with a private address range – not directly accessible from outside the firewall. Only web traffic, email traffic and management traffic shall be permitted through the firewall.
3.5.2	SRRPAS shall be patched with software security updates (OS, Database, etc.) as they become available.
3.5.3	Local physical security measures shall be implemented.
3.6	Constellation Data Mediator
3.6.1	SRRPAS shall maintain an up to date record of the GPS satellite constellation as well as scheduled changes to the constellation in order to ensure that the System calculations are based on the best available data.
3.6.2	The System shall obtain constellation data and constellation updates from a number of sources, as follows: <ul style="list-style-type: none"> a) United States Coast Guard (USCG). b) Almanac. c) Unscheduled outages/changes (NANU). d) AFTN/AMHS (as a future option). e) Unscheduled outages/changes (NOTAM).

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3.6.3	The constellation data mediator subsystem will provide the system with the best available picture of the constellation for the calculation time periods supported by the Tools.
3.6.4	The constellation data mediator subsystem shall also carry out the recalculation of static data in response to a constellation change to ensure that RAIM outage predictions are current and reliable.
3.6.5	The Constellation Data Mediator subsystem will be written to be resilient to errors in the data feeds from the external data sources. SRRPA will not update reference constellation data until it is verified as good with respect to format validity, range checking.
3.6.6	By using multiple data sources, GRPS will be able to use the best data available if one or more of the data sources is not functioning correctly. SRRPA will allow customisation of audit logging and notifications to system administrators based on errors detected in the source data (availability or content) to allow timely manual override of default behaviour and investigation of the issue if necessary.
3.6.7	The topographic data source of the application should come from a sufficiently reliable source.
3.7	SRRPAS Helpdesk
3.7.1	The bid winner should respond to queries related to SRRPAS and its operation via the SRRPAS Helpdesk, contactable via an Email address to be specified.
3.7.2	The bid winner shall assist in resolving issues at application level, specifically: <ul style="list-style-type: none"> a) To support the quality of the GPS RAIM predictions, b) Monitoring and validation of the US Notice Advisory to NAVSTAR Users (NANU) Service and GPS NOTAMs.
3.8	Bid Optional requirements
3.8.1	The bidder shall submit as optional within the bid, the following: <ul style="list-style-type: none"> a) Implementation in the menu functions, the generation of PDOP/GDOP both graphical and numerical to have the option of generating research processes within states that require it. b) Removal of artificial obstacles in the SAM terminal which will host the simulation in the approach phase, allowing a more accurate GPS RAIM simulation.

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SECTION D – SPARE PARTS, ACCESSORIES, TEST EQUIPMENT & TECHNICAL DOCUMENTATION	
1. TECHNICAL DOCUMENTATION	
1.1 The bid winner will supply an operational manual with the description of all the function of the SRRAP in soft-copy, in the English and Spanish language.	

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SECTION E – SERVICES, TESTS AND ACCEPTANCE

1. DATA CENTRE INSPECTION

- 1.1 The tenderer undertakes to submit for AAA/ICAO's approval at least forty-five (45) days prior to the scheduled commencement of the inspection, a Data-centre Inspection Plan and Procedures. ICAO shall notify the tenderer of its decision within thirty (30) days thereafter, and after an agreement has been reached, the plan/procedures shall form part of the eventual contract. Any changes in the plan/procedures initiated by the tenderer will be without cost to AAA/ICAO and subject to AAA/ICAO's approval.
- 1.2 The Data Centre Inspection includes the inspection of the hardware and software of the system that provide the SRRPAS. The software include the functionality of the SRRPAS, the WEB page of the service for the SAM Region and the SAM database.
- 1.3 All results of the data centre inspection shall be duly recorded and shall be signed by the tenderer's representative and AAA/ICAO representatives.
- 1.4 All observations agreed on and discrepancies noted during the Data Centre Inspection are to be corrected by the tenderer.
- 1.5 The tenderer shall arrange for a maximum of (2) inspections, to run consecutively for the facilities.
- 1.6 ICAO's appointed representative(s) together with AAA's representative(s) shall be entitled to enter the facilities of the tenderer at reasonable times during the normal working hours to witness the work in progress.
- 1.7 The Inspection shall be conducted in the presence of ICAO's appointed representative and representatives from AAA whose names shall be advised to the tenderer at least three weeks prior to the commencement of tests. Following the satisfactory completion of the tests, ICAO shall sign and issue a Inspection Certificate. It has been considered that three people will participate in the Inspection, one on behalf of ICAO and the remaining two on behalf of the AAA.
- 1.8 The costs of stay and passages from the three persons will be included in the offer of the bidder. It has been considered a minimum of three days (total) for the Inspections.

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1.9	If ICAO’s appointed representative does not issue and sign the Inspection Certificate, he shall immediately notify the tenderer in writing with proper reference to any tests in the approved Test schedule or to any part of the Specifications which the equipment has failed to meet. It is agreed between the parties that minor failures, which do not adversely affect the performance or operation of the equipment for the purpose intended and subsequently subject to modification by the tenderer at no extra cost, shall not be considered as items preventing Acceptance.
1.10	With respect to ICAO’s reason for non-acceptance, the tenderer shall give notice to ICAO stating how it intends to rectify in order that ICAO may repeat the tests that not initially comply and also the tests in respect of those parts affected by the rectification. The tenderer shall bear all costs associated with the re-testing (i.e. travel, accommodation and subsistence costs for ICAO’s/AAA’s representative(s) re-participation).
1.11	In the event of ICAO or AAA’s representatives failing to be present at the time and place appointed by the tenderer for the Factory Acceptance Tests, the tenderer may proceed with the tests which shall be deemed to have been made in the presence of ICAO and AAA’s representatives and the tenderer shall sign the Factory Acceptance Certificate for corresponding purposes which shall have the same meaning and value as if it had been signed by ICAO. A copy of the test results must be submitted to ICAO for review prior to shipment.
2.	TRAINING
2.1	General aspects
2.1.1	The Bidder shall include in its proposal a two-day operational training on the SRRPAS. The training will be carried out on-line.
3.	INSTALLATION
3.1	Nil.

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4. SITE ACCEPTANCE TESTS AND START-UP

4.1 The SAT shall be conducted in three(3) phases as follows:

- a) Provisional Site Acceptance Test (PSAT)
- b) Operational Readiness Demonstration (ORD) phase (30 days)
- c) Final Site Acceptance Test (FSAT)

4.2 The contractor shall provide written test plans and procedures, in Spanish language (If the language normally used by the Successful Bidder is other than Spanish, a set of documents shall be delivered in English) for the PSAT and FSAT. Copies of the detailed test plan and procedures are to be provided to ICAO/AAAs for approval not less than 30 days prior to the conduct of the tests. The SAT shall be witnessed by AAA/ICAO representatives.

4.2.1 Note that the Successful Bidder shall introduce the comments, and corrections suggested by ICAO/AAAs and shall re-submit such documents for approval, at no additional cost for ICAO/AAA.

4.2.2 Any delays in the execution of the contract resulting from the non-approval of the aforementioned plans and procedures shall be attributable to the Successful Bidder and shall not give the right to extensions in the execution timeframes established in the contract.

4.3 The test plans and procedures shall contain at least the following

- a) Detailed test timetable, by day
- b) Test sites and schedules
- c) List of participants on behalf of the Successful Bidder
- d) Purpose of the test
- e) General description of the SRRAP to be tested.
- f) Description of test procedures and steps
- g) Lists/tables with expected results
- h) Complete operational manuals of the equipment to be tested

4.4 The successful bidder shall demonstrate at PSAT phase, using mutually agreed upon test procedures, that all the equipment provided within this project is compliant to the technical specification and requirements. All deficiencies identified at the PSAT phase shall be corrected by the successful bidder prior to the FSAT phase.

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- 4.5 PSAT tests shall be conducted for the service operation , covering at least the following aspects:
- Connectivity to the WEB page
 - Functionality of all the parts of the SARRPS described in Section C part 2
 - Verify the content and quality of the data base of location and waypoint of the SAM Region
 - Documentation
- 4.6 There shall be a 30 day period between the PSAT and FSAT phases. During this period of 30 days, the AAA personnel shall be operating the system normally in order to identify any defects, adjustments, , etc. which shall be corrected by the successful bidder prior to the FSAT
- 4.7 When all the deficiencies identified during the PSAT and all abnormal situations identified during the 30 days operational readiness test phase are corrected, then the FSAT can take place.
- 4.8 The contractor shall provide the test equipment required for the SAT (if any).
- 4.9 All results of the SAT shall be duly recorded and shall be signed by the contractor. These results shall form the basis for the installation acceptance and for station records.
- 4.10 During acceptance (PSAT, ORD and SAT), the Project Office may include additional testing, as necessary, in order to ensure the correct operation of the supply of the website. These tests shall be automatically included as a supplement to the official test programme.
- Start-up**
- 4.11 The start-up of the service will commence upon approval of PSAT. The Successful Bidder will start the provision of the SRRPAS for the 24 hours a day, 7 days a week (24x7). The service will be in a preoperational phase for of 30 day period

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<p>SECTION E – SERVICES, TESTS AND ACCEPTANCE</p>	
<p>5. GUARANTEES / PERFORMANCE OF THE SERVICES</p>	
<p>5.1 The Successful Bidder shall maintain the quality of the service during the term of the contract, 24 hours per day, 7 days a week (24x7).</p>	
<p>5.2 The Successful Bidder shall provide access to a support centre to handle queries about the functionality of the service.</p>	
<p>5.2.1 In the event of unavailability of the service, a user may contact this centre via an email or phone call to report the event. In this act, the Successful Bidder must provide the relevant claim number for its use in the discount calculation referred in this section, as well as send an email to the user and to the ICAO SAM Regional Office</p>	
<p>5.2.2 Once the claim has been solved, the Successful Bidder will send an email to the ICAO monitoring bureau, and to every user who made the complaint, informing the solution and indicating the time it was settled and the number of claim.</p>	
<p>5.2.3 The time between the start of the contingency registered in the number of claim and its end, registered in the e-mail sent by the Successful Bidder, is the corresponding to T_i = "total time of unavailability" mentioned below. In case that a month registers several contingencies, the T_i will account for the total unavailability time.</p>	
<p>5.3 Preventive maintenance should be performed during the period of the services, without prejudice to the service operation, and must be communicated with a minimum of 10 (ten) business days via fax or e-mail.</p>	
<p>5.4 The Successful Bidder shall provide to ICAO at the time of the commencement of the contract, the list of the persons in charge for the service provision in hierarchical order.</p>	
<p>Discounts due to outage</p>	
<p>5.5 The Successful Bidder shall provide a discount for the disruption in the prediction services if the required availability in these specifications is not met (99.5%).</p>	

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5.6 If the responsible of the failure is the Successful Bidder, penalties will be applied consisting in the reduction in the payment of the cost of the service, according to the following scheme:

$I = \frac{T_i \times P}{T_o}$	<p>Where:</p> <p>I = monthly discount in USD, relative to the service in fault.</p> <p>T_o = operation period (01 month), in minutes.</p> <p>T_i = total time of unavailability of the service , occurred during the considered operation period (01 month), in minutes.</p> <p>P = monthly price of the Contract in USD.</p>
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5.7 The tenderer shall also warrant that all services delivered under an eventual contract shall perform in accordance with and conform to all specifications, descriptions, and other requirements included in the offer and shall be without defects in materials, workmanship and design. Failing to accomplish these performance criteria, the tenderer must modify/add and/or exchange the inadequate equipment and/or software, if necessary, to provide the specified functions.

5.8 Approval or acceptance of the tenderer's designs or acceptance of the system shall not prejudice ICAO/AAA's rights under this Article.

5.9 The rights under this Article shall be enforceable by the AAAs and ICAO respectively.

5.10 ICAO's and AAA's rights under this Article are not exclusive and any other rights provided in this Contract or by Law are reserved.

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TITLE: SAM REGIONAL RAIM PREDICTION AVAILABILITY SERVICE VIA WEB	COMPLIANCE STATEMENT

GLOSSARY OF ACRONYMS

For purposes of this document, the following acronyms will apply:

AAA	Aeronautic Administrations Authorities
AFTN	Aeronautical fixed telecommunication network
AMHS	Air Traffic Services Message Handling Services
Beidou	Global Navigation Satellite System (GNSS) developed in China
FD	Fault Detection
FDE	Fault Detection and Exclusion
FSAT	Final Acceptance Test in the Site
GALILEO	Global Navigation Satellite System developed the European Union (EU)
GDOP	Geometric Dilution of Precision
GLONASS	Global Navigation Satellite System of Russia
GPS	Global Positioning System
IP	Internet Protocol
PBN	Performance-based Navigation
PDOP	Positional Dilution of Precision
PSAT	Provisional in site Acceptation Test
NANU	NAVSTAR Users Advertisement Service
RAIM	Receiver Autonomous Integrity Monitoring
RNAV	Area Navigation
RNP	Required Navigation Performance
RNP APCH	Required Navigation Performance in Approach
RNP AR APCH	RNP Authorization Required Approach
SRRPAS	SAM Regional RAIM Prediction Availability Service
URL	Uniform Resource Locator
USCG	United States Coast Guard
UTC	Universal Time Coordinated

APPENDIX F / APENDICE F

EVALUATION METHOD - SERVICES (Field Projects + Regular Program)

Evaluation of SERVICES is done on a BEST VALUE FOR MONEY basis.

Criteria	Method
Formal / Corporate	PASS/ FAIL
Technical	Points (as per below table)

Step	Preparation of Evaluation Template (prior to Sealed Tender process):		
1	Finalize the Terms of Reference (TOR). Include an itemized list of services for which the tenderer shall provide prices.		
2	Customize the Formal and Technical criteria with keywords of the major criteria from the TOR; insert additional lines as needed. The criteria must refer to the appropriate paragraph in the TOR. Determine the maximum score achievable for each criteria, based on its relevance for the evaluation. Technical criteria shall account for 60% and Price for 40% of the evaluation.		
3	Adjust the Evaluation Summary by listing the services in the Technical Evaluation that shall be evaluated (as per itemized list of Step 1).		
Step	Evaluation (after Sealed Tender has closed):		
1	Prepare one Evaluation - Proposal Tab for each proposal received.		
2	Fill in the Formal Criteria and Corporate Eligibility Criteria (PASS/FAIL). If all criteria are answered with "PASS", the supplier is eligible for evaluation of Technical Criteria. If not all criteria are answered with "PASS", the supplier is disqualified.		
3	Evaluate the Technical Criteria (POINTS) for all suppliers which pass Step 2. Assign the percentage of points received for each criteria as per below table.		
Step	Evaluation Summary:		
1	Suppliers who reach $\geq 70\%$ of points in the technical evaluation are eligible for commercial consideration. Acceptable suppliers: Fill in the prices and calculate the commercial score with formula $P = y (\mu/z)$; the lowest proposal gets maximum score.		
2	Contract award will be recommended to the company with highest combined score (technical + commercial points).		
Evaluated Criteria	Supporting Evidences	Scoring Scale	Example with max. score of 10
Excellent	Excellent evidence of ability to support and exceed contract requirements	100%	10
Good	Good evidence of ability to support and exceed contract requirements	90%	9
Satisfactory	Satisfactory evidence of ability to support contract requirements	70%	7
Poor	Marginally acceptable or weak evidence of ability to support contract requirement	40%	4
Very Poor	Lack of evidence to demonstrate ability to comply with contract requirements	10%	1
Not Submitted	Information has not been submitted or is unacceptable	0%	0

TECHNICAL EVALUATION - SERVICES

Evaluator name:

Sealed Tender/ RFQ:

Tenderer:

Date of evaluation:

FORMAL CRITERIA				
Attachment I of Tender Docs.		Description	PASS/ FAIL	Comments
		Attachment II "Terms of Reference" completed (Field Projects only)		
		Commercial Offer submitted		
		Detailed Technical proposal submitted		
		Schedule of implementation submitted		
		Supplier provided Financial information		
		Three (3) References provided		
		Proposal submitted before the closing date		
		Offer meets Validity period		
		Supplier Eligibility Declaration signed		

CORPORATE ELIGIBILITY CRITERIA				
No.		Description	PASS/ FAIL	Comments
		Corporate Experience and Capability		
		Provided proof of relevant years of experience as requested in Tender Documents		
		List of similar projects acceptable, as requested in Tender Documents		
		Customer references acceptable, as requested in Tender Documents		

TECHNICAL EVALUATION - SERVICES

Evaluator name:
 Sealed Tender/ RFQ:
 Tenderer:
 Date of evaluation:

		Corporate Standards and Policies		
		Company is ISO 9001:2000 certified or equivalent Quality Assurance System		
		Financial Standing		
		Total price of the proposal is $\leq 30\%$ of the Company's Annual Revenue		
		Quick Ratio [(Cash + Accounts Receivable)/ Current Liabilities] ≥ 1		

TECHNICAL CRITERIA

No.	Section No.	Description	Max. Points	Scoring %: 100% = Excellent 90% = Good 70% = Satisfactory 40% = Poor 10% = Very poor 0% = Not submitted	Points received [Points x %]	Comments
SECTION A - INTENT AND STANDARDS						
A	4	BASIC TECHNICAL CHARACTERISTICS	10			
A	5	GENERAL CONSIDERATIONS	10			
A	6	RULES AND STANDARDS	10			
A	7	ALTERNATIVES	10			
A	8	BIDDER'S EXPERIENCE	150			
A	9	BIDDER'S DOCUMENTATION	10			
		Subtotal	200		0	
SECTION B - GENERAL REQUIREMENTS						
B	1.1.1	The bidder provide the organizational chart	10			
B	1.1.2	The bidder prepare a project timetable	10			
B	1.1.3	The Successful Bidder shall be fully responsible for the design, selection of components and materials, and installation techniques	20			
B	1.1.5	The Successful Bidder shall appoint properly qualified personnel in sufficient number	20			

TECHNICAL EVALUATION - SERVICES

Evaluator name:

Sealed Tender/ RFQ:

Tenderer:

Date of evaluation:

B	1.1.6	The Successful Bidder shall prepare and submit Inspection tests	5	
B	1.1.7	The Successful Bidder shall prepare and submit the Final Acceptance Test (PSAT)	5	
B	1.1.8	The Successful Bidder shall be responsible for host maintain and manage the SRRAPS	50	
B	1.1.9	The Successful Bidder shall submit operation manual	20	
B	1.2.1	The Bidder shall assume full responsibility for the following issues: a) Project proposal, organisation and distribution of all works.	10	
		Subtotal	150	0

SECTION C - TECHNICAL REQUIREMENTS

C	1.1.1 to 1.1.7	General Features system	50	
C	2.1	SRRPAS shall be a web-based tool with access for SAM regional customers. The information in the web site must be presented in English, Spanish and Portuguese. The main URL and mirror URL shall be defined in conjunction with ICAO on behalf of the SAM Member States.	60	
C	2.2.1.1 to 2.2.1.3	GPS Status Tool	40	
C	2.2.2.1 to 2.2.2.5	Terminal/Approach tool	40	
C	2.2.3.1 and 2.2.3.2	Visibility tool	40	
C	2.2.4.1 to 2.2.4.8	Route tool	40	
C	3.1	SRRPAS shall be managed and operated by the successful bidder and shall be deployed across two geographically dispersed servers, at two different Data Centres, offering 24/7 service with a minimum availability of 99.5%	40	
C	3.2	SRRPAS application shall be hosted on an application server with a database back- end providing highly available file storage facilities	40	
C	3.3	The server shall be fault-tolerant and shall include support for hot-swapping of essential hardware such as disks and power supplies.	20	
C	3.4	Hardware SRRPAS	20	

TECHNICAL EVALUATION - SERVICES

Evaluator name:

Sealed Tender/ RFQ:

Tenderer:

Date of evaluation:

C	3.5.1 to 3.5.3	IP security	30	
C	3.6.1 to 3.6.6	Constellation data mediator	40	
C	3.7.1 and 3.7.2	SRRPAS Helpdesk	40	
C	3.8	Bid Optional requirements		
Subtotal			500	0

SECTION D – SPARE PART, TOOLS, ACCESSORIES, TEST EQUIPMENT AND TECHNICAL DOCUMENTATION

D	1.1	The bid winner will supply an operational manual with the description of all the function of the SRRAP.	30	
Subtotal			30	0

SECTION E – SERVICES, TESTS, AND ACCEPTANCE

E	1	INSPECTION TESTING	10	
E	2	TRAINING	30	
E	3	INSTALLATION	20	
E	4	SITE ACCEPTANCE TESTS AND START-UP (PSAT, FSAT)	10	
E	5	GUARANTEES / PERFORMANCE OF THE SERVICES	50	
Subtotal			120	0

Total punctuation (Sum of max punctuation A+B+C+D+E)	1000	0
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EVALUATION SUMMARY - SERVICES

Evaluator name:
 Sealed Tender/ RFQ:
 Date of evaluation:

Contract award will be recommended to the company with highest combined score (technical + commercial points).

TECHNICAL EVALUATION	Max. Score	Proposal 1	Proposal 2	Proposal 3
Formal Criteria: Supplier has met all Formal Criteria (PASS/FAIL)?				
Corporate eligibility criteria: Supplier has met all CEC (PASS/FAIL)?				
Technical Criteria 1 - Section A: Sub-Total of points received:	200			
Technical Criteria 2 - Section B: Sub-Total of points received:	150			
Technical Criteria 3 - Section C: Sub-Total of points received:	500			
Technical Criteria 4 - Section D: Sub-Total of points received:	30			
Technical Criteria 5 - Personnel E: Sub-Total of points received:	120			
Total technical points (proposals reaching ≥70% of Max. Score are eligible for commercial evaluation)	1000	0	0	0
COMMERCIAL EVALUATION	Max. Score	Proposal 1	Proposal 2	Proposal 3
Meets threshold >70% of Technical Evaluation?		YES/NO	YES/NO	YES/NO
Price of proposal without taxes: (Field Projects: Price includes all applicable local taxes)				
Price Score (P= y (μ/z); lowest proposal gets max. points)	1000			
Combined Score (0.6xTechnical Score + 0.4xCommercial Score):		0	0	0

For calculation of the price score, use this formula: **P = y (μ/z)**

P = points for the commercial proposal being evaluated
 y = maximum number of points for the commercial proposal
 μ = price of the lowest priced proposal
 z = price of the proposal being evaluated

In this methodology (Cumulative Analysis), the maximum number of points assigned to the commercial proposal is allocated to the lowest price proposal, technically compliant.
 All other price proposals receive points in inverse proportion.

Agenda Item 6: Operational implementation of new ATM automated systems and integration of the existing systems

6.1 Under this Agenda item, the Meeting analysed WP/12 - *Follow-up to the implementation of automated systems* and WP/28 – *Interconnection of the Amazónico ACC (Brasil) and Maiquetía ACC (Venezuela) automated systems*.

6.2 The Meeting took note of the results obtained by the mission of automation experts conducted to the SAM States that had signed the Memoranda of Understanding (MoU) for the interconnection of automated systems (Argentina, Chile, Peru and Uruguay), carried out from 5 to 16 August 2013, highlighting the causes identified which are still hindering the end of the interconnection works.

6.3 The Meeting, upon analysing the results of the mission, presented in WP/12, considered that the data interconnections for the automatic transfer of flight plans is of no problem to States in terms of date compliances. In this sense, many AIDC interconnections or Document 4444 messages could become operational before the end of 2013. For further information, refer to Agenda Item 5, paragraph 5.19.

6.4 Nevertheless, the Meeting, upon examining the topic relative to radar data interconnection through the use of ASTERIX 61 and 63 protocols, originated an extensive discussion that prioritized the subject of debate in the automation group.

6.5 In this respect, Brazil, through WP/28, informed on the results obtained from the final trials carried out in August 2013 regarding the integration of Maiquetia ACC with Amazonico ACC.

6.6 In its paper, Brazil highlighted that both ACC were already in the necessary technical condition for the interconnection of their automated systems (surveillance and flight plans), pending only operational agreement arrangements for their use. The operational agreements for the automated flight plan hand-off were included in the updated letter of agreement between Brazil and Venezuela, drafted during this SAM/IG meeting (see Agenda item 1). The date of applicability of the amended letter of agreement will be 12 December 2013.

6.7 The Meeting was informed that the Brazilian option to use Cat 62 ASTERIX protocol for the submittance of surveillance data to adjacent centres (AC) was based upon the *CAR/SAM Interconnection Plan* approved at GREPECAS/15 meeting and on the need to filter the data in accordance with the geographical region as defined in the various MoU signed with other States. Therefore, investments were carried out since 2009 on their automated systems.

6.8 Brazil highlighted that the specific aim of exchanging surveillance data is to increase the situational awareness of the controller responsible for the hand-off coordinations, especially those flights still under control of the AC.

6.9 The Meeting requested clarifications on the manner how, with the use of Cat 62 ASTERIX protocol, are the traces from the CA merged in the Brazilian and Venezuelan automated systems.

6.10 To answer to this query, the representative of ATECH delivered a small presentation to explain the merging rules applied in the Brazil and Venezuela automation systems. In this respect, he clarified that the cinematic data of the traces from the CA are not taken under consideration, except when the priority sensors (radars, ADS-B, MLAT) are unavailable. He also informed on the advantages in using the traces from an automated system such as, for example, information related with the flight plan (identification, CFL, etc.) and the greater availability of surveillance information.

6.11 The representative of INDRA informed that their automated systems are capable of receiving surveillance data in the ASTERIX 62 protocol, nevertheless, the company does not recommend the merging of surveillance sensors and trace from the CA, in view of the current delays. In addition, he suggested that one way to upload the traces from a CA in ASTERIX Cat 62 would be through an additional screen used to present flight plan information (FDD).

6.12 Argentina considered that the alternative presented by the INDRA representative would not meet operational requirements, as the information would be presented in an additional screen, an additional workload for the controller.

6.13 Taking under consideration the position of Brazil to send radar data through Cat 62 ASTERIX protocol, and the position of States using the INDRA system to not merge the data from their surveillance sensors with CA traces, the Meeting concluded that the interconnection MoUs between Brazil and the States using INDRA ATC centres (Argentina, Peru and Uruguay) should be reviewed upon.

6.14 In this manner, it was deemed convenient that the objective of the reviews to the MoUs would be to limit their scope to the exchange of flight plan data (AIDC), which is one of the data exchange alternatives foreseen in the *CAR/SAM interconnection* plan, and consider the exchange of radar data for a later date to be defined by both parties involved.

6.15 The Meeting, as a result of the discussions held by the automation group, examined their implementation goals, presented as **Appendix A** to this Agenda item.

6.16 Finally, to support States in the implementation of automation activities, the Meeting deemed it important to hold two events in 2014, a Course for the Interconnection of Automated Systems over ASTERIX and AIDC Protocols (Sao José dos Campos, Brazil, 24 to 28 February 2014), for technical and operational personnel and a Seminar/Workshop on Automated Systems, for ATS staff (Lima, Peru, 18 to 22 August 2014). One fellowship per project RLA/06/901 member State will be required for these courses. For the seminar/workshop, a mission from an automation will be additionally required. For both events, simultaneous interpretation services will be required.

APPENDIX A

INTERCONNECTION OF AUTOMATED SYSTEMS

State	AIDC and Radar Data Interconnection Requirements	MoU Date of Implementation	AIDC and Radar Data Interconnection Date	Remarks
Argentina	Bolivia	TBD	TBD	Bolivia has no automated systems
	Brazil	2009	Aug 2014	MoU implemented The interconnection will only include AIDC by the indicated date. Radar data interconnection has been postponed to a date to be determined. AIDC interconnection meets the requirements specified in the regional action plan for the interconnection of automated systems
	Chile	2010	Jul 2014	MoU implemented
	Paraguay	May 2014	Dec 2014	
	Uruguay	2009	Jun 2014	MoU implemented
Bolivia	Argentina	TBD	TBD	Bolivia has no automated systems
	Brazil	TBD	TBD	
	Chile	TBD	TBD	
	Paraguay	TBD	TBD	
	Peru	TBD	TBD	
Brazil	Argentina	2009	Aug 2014	MoU implemented The interconnection will only include AIDC by the indicated date. Radar data interconnection has been postponed to a date to be determined. AIDC interconnection meets the requirements specified in the regional action plan for the interconnection of automated systems
	Bolivia	TBD	TBD	Bolivia has no automated systems

State	AIDC and Radar Data Interconnection Requirements	MoU Date of Implementation	AIDC and Radar Data Interconnection Date	Remarks
	Colombia	Oct 2014	Jul 2015	The interconnection will only include AIDC by the indicated date. Radar data interconnection has been postponed to a date to be determined. AIDC interconnection meets the requirements specified in the regional action plan for the interconnection of automated systems
	Guyana	TBD	TBD	Define requirement
	French Guiana (France)	TBD	TBD	Define requirement
	Paraguay	Oct 2014	Mar 2015	The interconnection will only include AIDC by the indicated date. Radar data interconnection has been postponed to a date to be determined. AIDC interconnection meets the requirements specified in the regional action plan for the interconnection of automated systems
	Peru	2012	Sep 2014	MoU implemented The interconnection will only include AIDC by the indicated date. Radar data interconnection has been postponed to a date to be determined. AIDC interconnection meets the requirements specified in the regional action plan for the interconnection of automated systems
	Suriname	TBD	TBD	Define requirement
	Uruguay	2009	Aug 2014	MoU implemented The interconnection will only include AIDC by the indicated date. Radar data interconnection has been postponed to a date to be determined. AIDC interconnection meets the requirements specified in the regional action plan for the interconnection of automated systems

State	AIDC and Radar Data Interconnection Requirements	MoU Date of Implementation	AIDC and Radar Data Interconnection Date	Remarks
	Venezuela	2011	Dec 2013	MoU implemented The interconnection will only include AIDC by the indicated date. Radar data interconnection has been postponed to a date to be determined. AIDC interconnection meets the requirements specified in the regional action plan for the interconnection of automated systems
Chile	Argentina	2010	Jul 2014	MoU implemented
	Peru	Jun 2014	Mar 2015	
Colombia	Brazil	Oct 2014	Jul 2015	
	Ecuador	May 2014	Dec 2014	
	Panamá	May 2014	Dec 2014	
	Peru	Oct 2014	Jul 2015	
	Venezuela	Dec 2014	Dec 2015	
Ecuador	Colombia	May 2014	Dec 2014	
	Peru	Oct 2013	Jun 2014	
French Guiana (France)	Brazil	TBD	TBD	Define requirement
	Surinam	TBD	TBD	Define requirement
Guyana	Brazil	TBD	TBD	Define requirement
	Surinam	TBD	TBD	Define requirement
	Venezuela	TBD	TBD	Define requirement
Panama	Colombia	May 2014	Dec 2014	
Paraguay	Argentina	May 2014	Dec 2014	
	Bolivia	TBD	TBD	Bolivia has no automated systems
	Brasil	Oct 2014	Mar 2015	
Peru	Bolivia	TBD	TBD	Bolivia has no automated systems
	Colombia	Oct 2014	Jul 2015	
	Chile	Jun 2014	Mar 2015	
	Ecuador	Oct 2013	Jun 2014	
Surinam	Brazil	TBD	TBD	
	French Guiana (France)	TBD	TBD	
	Guyana	TBD	TBD	
Uruguay	Argentina	2009	Jun 2014	
	Brazil	2009	Aug 2014	MoU implemented
Venezuela	Brazil	2011	Dec 2013	MoU implemented
	Colombia	Dec 2014	Dec 2015	

Agenda Item 7: Other business

7.1 Under this Agenda item, Brazil requested the possibility that the next SAM/IG/13 meeting be carried out in April 2014, instead of May, month when these meetings are normally scheduled, due to preparations for the FIFA World Cup to be held in Brazil from 12 June to 13 July 2014.

7.2 In this respect, the Meeting approved the change of date requested and deemed convenient that the SAM/IG/13 meeting be held from 7 to 11 April 2014.

7.3 The Meeting was informed on the Syrius ATM Seminar carried out by Brazil (DECEA) in Rio de Janeiro, from 14 to 17 October 2013. All presentations can be seen in YouTube under “Seminario ATM Syrius Brasil”.