SAM/IG/11

INTERNATIONAL CIVIL AVIATION ORGANIZATION
South American Office

Regional Project RLA/06/901

ELEVENTH WORKSHOP/MEETING OF THE SAM IMPLEMENTATION GROUP

(SAM/IG/11)

FINAL REPORT

Lima, Peru, 13 to 17 May 2013

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HISTORY OF THE MEETING

ii-1 PLACE AND DURATION OF THE MEETING

The Eleventh Workshop/Meeting of the SAM Implementation Group (SAM/IG/11) was held at the premises of the ICAO South American Regional Office in Lima, Peru, from 13 to 17 May 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. Also, he announced the joining of Colombia and Ecuador to RLA/06/901 Project and encouraged the Group to continue with obtaining tangible results in benefit of the States of the Region.

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

The Meeting agreed to hold its sessions from 08:30 to 15:00 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 Mr. Roberto Arca, RO/ATM/SAR/AIM.

ii-4 WORKING LANGUAGES

The working language of the Meeting was Spanish, with simultaneous interpretation in English, and its relevant documentation was presented in Spanish and English.

ii-5 AGENDA

The following agenda was adopted:

Agenda Item 1: Follow up to conclusions and decisions adopted by SAM/IG meetings and results on the Twelfth Air Navigation Conference (AN-Conf/12)

Agenda Item 2: SAM airspace optimization

Agenda Item 3: Implementation of performance-based navigation (PBN) in the SAM Region

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 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: Implementation of the new flight plan format

Agenda Item 8: Other business

ii-6 **ATTENDANCE**

The meeting was attended by 68 participants from 11 States of the SAM Region (Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Uruguay and Venezuela), 1 International Organization (IATA) and 8 International Companies (AIRBUS-METRON, AIRBUS-PROSKY, ARINC, ATECH, BOEING-JEPPESEN, EMBRAER, ICCAIA-BOEING, and THALES Air Systems). The list of participants is shown in page iii-1.

ii.7 **LIST OF CONCLUSIONS**

No.	Title of the Conclusion	Page
SAM/IG/11-1	Support to SAM States in the redesign of their TMA	2-4
SAM/IG/11-2	Implementation of the concept on the flexible use of airspace in the ICAO South American Region	2-5
SAM/IG/11-3	Basic PANS-OPS Course	3-4
SAM/IG/11-4	International AMHS interconnection	5-4
SAM/IG/11-5	Use of the radio frequency spectrum	5-6

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Agenda Item 1: Follow up to conclusions and decisions adopted by SAM/IG meetings and report on results of the Twelfth Air Navigation Conference (AN-Conf/12)

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/18 *Follow-up to Recommendations of the Twelfth Air Navigation Conference* (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.

1.3 The Meeting identified in Appendix A some tasks that were repeated in the Action Plans, and considered their elimination from the list contained in this Appendix. In addition, it deemed convenient for the Secretariat to follow-up on all conclusions and tasks with no completion date (permanent), and to exclude them from the list of conclusions and tasks. This action will be carried out starting on the next SAM/IG meeting.

Follow-up to recommendations of the Twelfth Air Navigation Conference

1.4 The Meeting went on to analyse the recommendations of the Twelfth Air Navigation Conference applicable to the SAM/IG work programme, and in this regard, considered same, within the Block 0, were aligned with the activities contemplated in its work programme, except for matters relating to regional harmonization of transition altitude (Rec 5/1, ANC/12).

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
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: 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; b) reflect in this AIC the specific YEStuations within the airspace under their jurisdiction.	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**--**	**YES**	**YES**	**YES**	**YES**	**O/G**	**YES**	**YES**	**GUY:** Nov. 2009 **SUR:** Will inform Nov.15, 2009
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: a) Aircraft operating commercial flights, which have more than 5 700 kg. of MTOW – 15 February 2009; b) Aircraft operating commercial flights, which have less than 5 700 kg. of MTOW – 15 May 2009; c) Other aircraft registered in the Region–15 Aug 2009.	**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 few 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.
2-13 **1.2** 1.2 Collect air traffic data to understand air traffic flows in a specific airspace.	**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
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.	**O/G**	**O/G**	**YES**	**YES**	**YES**	**O/G**	**--**	**O/G**	**O/G**	**YES**	**NO**	**O/G**	**YES**	**YES**	**ECU:** ATFM **PER:** Mar 2010
4-5 **Initial ATFM AIC Model**	**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
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.	**YES**	**YES**	**YES**	**YES**	**O/G**	**--**	**--**	**--**	**-**	**YES**	**YES**	**--**	**YES**	**YES**	**VEN:** pertinent actions taken
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.	**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
3-5 **Conclusion SAM/IG/3-5** **Runway capacity of an international airport and ATC associated sector** 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: 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.	**O/G**	**YES**	**YES**	**YES**	**YES**	**YES**	**--**	**--**	**--**	**YES**	**YES**	**--**	**NO**	**YES**	**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.
Conclusion SAM/IG/4-1 **SAM routes network point of contact** 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.	**YES**	**YES**	**YES**	**YES**	**YES**	**--**	**--**	**--**	**--**	**YES**	**YES**	**--**	**YES**	**YES**	**BOL:** César Varela **URU:** Gustavo Turcatti Tel.5982 604 0408 Int 5111 blantur@gmail.com **VEN**: Carlos Gonzalez and Pablo Rattia
Conclusion SAM/IG/4-2 **Advisory Circulars for Aircraft approval and operators for RNP 10 operations, RNAV 5, RNAV 1 and 2, Basic RNP 1, RNP APCH, RNP AR APCH and APV/baro-VNAV** That States of ICAO South American Region, according to the PBN implementation plans: a) use the Advisory Circulars (AC), in developing their acceptable means of compliance of approval of aircraft and operators for RNP 10 operations, RNAV 5, RNAV 1 and 2, Basic RNP 1, RNP APCH, RNP AR APCH and APV/baro-VNAV, that are shown in	**O/G**	**YES**	**O/G**	**YES**	**YES**	**O/G**	**O/G**	**O/G**	**O/G**	**YES**	**YES**	**O/G**	**YES**	**YES**	**BOL**: published in RAB 91. **COL**: Following information circulars: CI-5102-082-001 CI-5102-082-002 CI-5102-082-003 CI-5102-082-008 CI-5102-082-009 CI-5102-082-010 **PAR**: in final process of publication. **VEN**: RNP10, RNAV2, RNP APP AR pending.

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
Appendices A1, A2, B1, B2, C1, C2, D1, D2, E1, E2, F1, F2, G1 and G2 of this part of the report; and b) that job aids of aforesaid circulars be incorporated into Inspector's manuals of Operations and airworthiness.	--	--	--	**YES**	**YES**	--	--	--	--	--	----	--	--	--	**COL**: Airworthiness inspector guide can be consulted at hyperlink: Guía inspector Aeronavegabilidad
Conclusion SAM/IG/4-3 Continued data collection about PBN Fleet Capacity in the South American Region The Meeting considered that: a) efforts should be continued in order that each State, through its PBN Focal Points, conduct such actions to send, as soon as possible, information, about its PBN fleet capacity to ICAO Regional Office. The information collected by States should, as far as possible, be sent to the Regional Office in a file with Excel format. b) that each State is responsible for providing data and, as time passes, updates or further details on the submitted data should be made; c) to facilitate the updating of data, the file of the survey of each state 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.	**O/G**	**O/G**	**O/G**	**YES**	**YES**	**O/G**	**O/G**	**O/G**	**O/G**	**O/G**	**NO**	**O/G**	**YES**	**YES**	**COL:** Had the same difficulties as Venezuela, and finally the information was collected. However, we believe this item should be considered as completed since it was pre-assessment and we are now in the implementation process. **VEN:** fruitless surveys have been carried out in view of the poor knowledge that operators and aircraft owners have. A dissemination campaign is being carried out to enable improvement of data provided by the same.
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.

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
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
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.

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
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 weekly ATFM teleconferences between flow management units or flow management positions (FMU / FMP) to improve the exchange of information among participating States.	**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 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**	

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
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 CARSAMMA 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
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**	

Conclusión/Tarea **Conclusion/Task**	**ARG**	**BOL**	**BRA**	**CHI**	**COL**	**ECU**	**FGY**	**GUY**	**PAN**	**PAR**	**PER**	**SUR**	**URU**	**VEN**	**OBSERVACIONES** **REMARKS**
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).
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:	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
a) Require from their AMHS providers the necessary support to successfully end the necessary interconnections;	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**N/A**	**YES**	**NO**	**YES**	**YES**	**YES**	**O/G**	**YES**	An AMHS course has been coordinated with the Eurocontrol Instilux institute, to support States in AMHS interconnection (Lima, Peru July 2012) and a ground-ground, ground-air data imterconnection implementation Workshop/Seminar (Lima, Peru, September 2012). A second COM AMHS course with Eurocontrol Instilux Institute is planned for 24-28 June 2013.
b) Make necessary arrangements to train personnel in the interconnection tasks, with the aim of minimizing the dependency with their providers;	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**N/A**	**YES**	**NO**	**YES**	**YES**	**YES**	**O/G**	**YES**	
c) Maximize pertinent coordination; and	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**N/A**	**YES**	**YES**	**YES**	**YES**	**YES**	**O/G**	**YES**	
d) States that have not yet done so, complete the drafting and signature of the MoU.	**O/G**	**N/A**	**O/G**	**O/G**	**O/G**	**O/G**	**N/A**	**O/G**	**O/G**	**YES**	**O/G**	**O/G**	**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/6-11 Changes in the AMHS systems and in the FDP for the implementation of Amendment 1 to the PANS/ATM 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.	**YES**	**O/G**	**O/G**	**O/G**	**O/G**	**O/G**	**O/G**	**YES**	**O/G**	**O/G**	**YES**	**YES**	**O/G**	**O/G**	
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,	**YES**	**YES**	**--**	**YES**	**YES**	**--**	**--**	**--**	**--**	**YES**	**--**	**--**	**YES**	**--**	

Conclusión/Tarea **Conclusion/Task**	**ARG**	**BOL**	**BRA**	**CHI**	**COL**	**ECU**	**FGY**	**GUY**	**PAN**	**PAR**	**PER**	**SUR**	**URU**	**VEN**	**OBSERVACIONES** **REMARKS**
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.															
Conclusion SAM/IG/7-4 **Publication of the trigger NOTAM** That SAM States publish the trigger NOTAM no later than 13 October 2011, using the following model: In keeping with AIC xx and AIP Supplement xx, RNAV-5 will start to be applied on RNAV routes of the continental airspace in the xx FIR at 09:01 UTC of 20 October 2011.	**YES**	**YES**	**YES**	**YES**	**YES**	**--**	**--**	**--**	**--**	**YES**	**YES**	**NOV/12**	**YES**	**YES**	
Conclusion SAM/IG/7-6 **Updating of the DME DME study** That SAM States, when making any changes to DME systems, inform the ICAO SAM Regional Office so that it may update and distribute the DME DME coverage study to support RNAV-5.	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**Continuous activity**
Conclusion SAM/IG/7-8 **Safety assessment for the implementation of Amendment 1 to the 15th Edition of ICAO PANS ATM (Doc 4444)** That SAM States, taking into account the regional strategy for the implementation of Amendment 1 to the 15th Edition of ICAO PANS ATM (Doc 4444), adopt the corresponding measures to conduct a safety assessment for the implementation of Amendment 1 to the PANS-ATM, and send it to the ICAO SAM Regional Office no later than **30 November 2011.**	**YES**	**YES**	**YES**	**YES**	**YES**	YES	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**COMPLETED**
Conclusion SAM/IG/8-3 - Implementation of a RAIM/FDE prediction system in the SAM	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**O/G**		**YES**	**YES**	**YES**	**O/G**	**YES**	**YES**	a) The Sixth RLA/06/901 Project Coordination Meeting

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
Region That, in order for the FDE SAM Region to have a common service for predicting RAIM and FDE availability to support PBN operation for en-route, non-precision approach, vertical guide approach (APV) and terminal area: a) the Fifth Meeting of the Coordination Committee of Regional Project RLA/06/901 consider the purchase of the RAIM prediction service selected between the proposals presented by DWI and Colombia; and b) ICAO analyse the most convenient way for States that are not members of Regional Project RLA/06/901 to pay the corresponding fee for the RAIM prediction service.															(Lima, Peru, 21 to 23 November 2012) approved acquisition and implementation of FAIM availability prediction service through Conclusion RCC/6/4. b) Service will initiate with Project RLA/06/901 member States. Project document was amended with inclusion of RAIM availability prediction service. Technical specifications for implementation of RAIM availability prediction service was sent to ICAO technical cooperation section to initiate tender process.
Conclusion SAM/IG/9-4 **Active participation in all regional activities for the implementation of Amendment 1 to Doc 4444, 15th Edition** That the SAM States, with the aim of complying with the implementation of Amendment 1 to ICAO Doc 4444, 15th Edition:															**COMPLETED**
a) Inform of any changes in the list of focal points shown in Appendix B to this Agenda Item;	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	
b) Actively participate through their focal points in the web teleconferences scheduled in the following dates: 25 May, 29 June, 31 August, 28 September and 31 October 2012; and	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**NO**	**NO**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	
c) Participate in the scheduling of the regional and inter-regional trials described in Appendix E to this Agenda Item.	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**		
Conclusion SAM/IG/10-1 **Safety Plan for the implementation of routes Phase 3, Version 02**															

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
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.															
Conclusion SAM/IG/10-2 Implementation of the new concept of flexible use of the airspace in the ICAO South American Region That States in the SAM Region, if deemed appropriate, recommend the definitive approval of the Guidelines for the Implementation of the Flexible Use of Airspace Concept in the ICAO South American Region for the design and airspace management of the flight information region under their jurisdiction.															
Conclusion SAM/IG/10-3 Review of the Guide on technical and operational considerations for the implementation of ADS-B That, in order to review the Guide on technical and operational considerations for the implementation of ADS-B: a) The Secretariat circulate the Guide to SAM States on the last week of October 2012; and b) SAM States send their comments by 31 December 2012.	**NO**	**NO**	**YES**	**YES**	**NO**	**NO**	**NO**	**YES**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**COMPLETED**
Conclusion SAM/IG/10-4 Updating of the ICAO FITS website That, SAM States that have not done it yet, are urged to inform the ICAO South American Regional Office, by 17 October 2012, the date in which they will start accepting the NEW flight plan format, so that ICAO may update the FITS website (http://www2.icao.int/en/FITS/Pages/home.aspx) for display to all the global aeronautical community.	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**COMPLETED** FPL 2012 was implemented successfully on the date foreseen.

Instrucciones para el llenado del formulario - Instructions to fill in the form

- Cumplida: colocar **Sí** en el casillero correspondiente. / Accomplished: place **YES** in the corresponding box
- En ejecución: colocar **O/G** (on going) e indicar en "observaciones" la fecha prevista de término./ In execution: place **O/G** (on going) and indicate under "remarks" the estimated deadline
- No cumplida: colocar **NO** en el casillero correspondiente y, de ser el caso, hacer comentarios en columna de observaciones/ Not complied: place **NO** in the corresponding box and if such were the case, make comments in the remarks column

Agenda Item 2: SAM airspace optimization

2.1 The Meeting took note that the SAM/IG/10 meeting had continued analysing the feasibility of the routes approved by the ATS/RO/4 meeting, in order to proceed with the analyses foreseen and the provision of information on the gateways of the respective terminal areas.

2.2 Likewise, the airline operators flying these routes conducted studies of the proposed routes, taking into account flying time over the mountain range, single-engine flying time, weather and volcanic conditions, etc. which might affect them, and presented these additional analyses.

2.3 The Meeting took note of the Brazilian request to conduct the implementation by phases, based on route packages for certain complex flows, taking into account that a significant traffic increase was expected in some critical areas as a result of world sport events.

2.4 The Meeting recognised that it might not be possible to implement the whole route package by the expected date and that Brazil would not be possible to implement some routes until the second half of 2014.

2.5 Taking into account that much progress was being made in the Region in terms of route optimization, the Meeting felt the need to continue concurrently with airspace optimization, extending it to terminal areas.

2.6 In this regard, the Meeting resolved that the ATS/RO meetings would continue to manage the Route Optimization Programme, and this and subsequent meetings will address the optimization of terminal areas with PBN procedures and continuous descent and climb operations (CDO and CCO respectively).

2.7 It was also felt advisable for this meeting to discuss some routes that were pending, providing their coordinates and proceed with their immediate implementation to obtain early operational benefits.

2.8 States like Ecuador and Colombia, that now are members of Project RLA/06/901, may propose and/or approve the optimization of routes that are of interest to users between pairs of cities, and prepare their inclusion in the ATS/RO Programme in the corresponding formats.

Route Guayaquil-Madrid

2.9 Amongst the routes long pending implementation is the direct route between Guayaquil and Madrid (UM662), which could not be implemented due to restricted areas along its path, and has been deferred several years.

2.10 Regarding **Route UM662**, Venezuela proposed a modification to the following path: **Guayaquil BIVAN/ILVIR/AMAYA/EGOSU/DAREK Madrid** and, if stakeholders agree, the required coordinates shall be provided for its implementation and the corresponding proposal of amendment shall be submitted (see **Appendix A).**

Routes Guayaquil-Lima and Quito-Lima

2.11 Other two direct routes that have been requested by users are the **Guayaquil-Lima** and **Quito-Lima** routes, which require coordination and studies for early implementation or inclusion in the route package selected under the ATSRO Programme.

2.12 In view of the above, after the corresponding analysis by the experts of the Peruvian and Ecuadorian administrations, the meeting took note that:

a) At present DGAC Peru has started the activities of the “Airspace Optimization Program – PBN (PROESA-PBN)”, which expects the participation of the users and the ANSP CORPAC in the planning of a new PBN airspace in the Lima FIR. In this context, the configuration of Lima TMA and respective gateways are being revised.

b) **Guayaquil-Lima Route -** At present this pair of cities are linked by a segment of airway UL780 (Miami-Santiago corridor), which connects in the VOR TRU with route UG436 continuing to the South up to Lima VOR (VOR LIM). The route UG436 together with the other routes converge since March 2011 in a point of arrival and sequencing to runway15 of the AIJCH denominated ATOGO (120 NM to the North of Lima).

c) **Quito-Lima Route -** Currently this pair of cities are linked by the RNAV UM674 airway, which replaced in due course the conventional route UG426. Analogously to the indicated in the preceding paragraph, the route is also aligned with the ATOGO point.

2.13 Based on the above, having been implemented the ATOGO point since March 2011within the Lima FIR as a sequencing point for the arrivals from the North to runway 15of the Jorge Chavez International Airport and based on the analysis of the DGAC Peru, this point should be kept in its present location in the context of the new PBN space of the Lima FIR, in view that it results non-viable to implement new routes to link in a direct way Guayaquil-Lima and Quito-Lima, as this would alter the traffic flows that currently converge into ATOGO.

2.14 In view of the aforementioned, in order to advance the necessary tasks for the ATS/RO/5 meeting where the ATSRO Programme will be discussed, the Meeting deemed it convenient that Ecuador, which did not attend the SAM/IG/10 meeting, analyse and study Appendix A of Item 2 of SAM/IG/10 report to submit their analysis in the next ATS/RO/5 meeting in relation to all the routes considered of interest to their FIR.

Airspace design course

2.15 Regarding the development of **Phase 3**, Version 02 of the SAM Route Optimization Programme, the Meeting took note that the SAM/IG/7 meeting revised the planning of the relevant tasks to match its associated Action Plan in order to implement **Version 02** of the ATS route network.

2.16 The Meeting recalled that the ATS/RO/3 meeting felt that Phase 3 should involve a complete restructuring of the route network, with a view to full integration of ATS routes, control sectors, TMAs, etc., through the use of the Flexible Use of Airspace concept. In this regard, the Meeting approved the modifications and improvements to the Action Plan, Phase 3 Version 02 of the SAM ATS Route Optimization Programme.

2.17 The Meeting considered that, amongst the new activities, an important one was the conduction of a Seminar/Workshop on Airspace Planning, aimed at preparing airspace planners of the States of the Region for the integration of TMAs into this optimization process.

2.18 Pursuant to task 3.2.5 of the ATSRO Action Plan, a Course/Workshop on airspace design for the CAR/SAM Regions was held in Miami, United States, on 11-22 March 2013.

2.19 The purpose of this Course/Workshop was to train experts of the Region for addressing the phase involving airspace design in terminal areas based on the PBN concept, thus enabling the completion of Phase 3 of the Route Optimization Programme being carried out by Project RLA/06/901 in the SAM Region.

2.20 IATA supported this Course/Workshop by providing logistics and instructors (Messrs. Joel Morin and Walter White), and CANSO paid for simultaneous interpretation services for the theoretical part of the course on the first week. Project RLA/06/901 sent two experts on behalf of the Project.

2.21 Before starting the Workshop and as required by the organizers, the on-line courses of the PBN and airspace design training package were conducted. The on-line PBN courses -PBN Overview and PBN Airspace- are available at www.icao.int/pbn, *Web-based training*, including the *ilearn* package.

2.22 The Workshop presented the participants with the best practices contained in the ICAO PBN and CCO/CDO Operations Manual, highlighting some examples and other experiences in complex terminal areas. As an example, the participants also had a chance to watch a fast-time simulation of a post-terminal area optimization scenario.

2.23 The Course/Workshop reinforced the knowledge of participants about airspace design, taking into account the PBN concept. The practical exercises chosen were quite appropriate because of their diversity, covering both en-route and TMA operations.

2.24 The ATM/COM/NAV/SUR capabilities of the States (Peru and Mexico), as well as traffic volume, fleet mix, equipage and traffic flow analyses, were taken into account for solving real operational problems in a selected airspace. A door-to-door approach was applied in a major traffic flow.

2.25 The participants were experts of the following SAM States: **Argentina, Brazil, Colombia, Paraguay** and **Peru** as well as two experts from Project RLA/06/901 that provided constant support to the working groups with their knowledge. A total of 8 experts of the SAM Region and 2 designers of South American airlines were trained. The terminal area selected was the Lima TMA (Peru), in the SAM Region, and the Cancun TMA in the CAR Region.

2.26 Another important feature was the participation of procedure designers of the LAN Group, ATM experts of American Airlines and European experts on fast-time simulation tools, who kindly offered their support and software.

2.27 The experts of these States had a chance to learn how to develop a project for the incorporation of the new airspace structure, with clear dates and milestones. The course duly qualified them to provide training on airspace design in their State and in the Region.

2.28 Last but not least, the excellent cooperation and coordination provided by Mr. Carlos Cirilo of IATA Montreal for the organization of this event should be acknowledged, together with the previous organization and coordination work done by our ATM/SAR colleague, Mr. Celso Figueiredo.

2.29 The participating SAM States have now the knowledge required to continue with their PBN implementation programmes, as well as the PBN Programme for the SAM Region, as shown by the high level of the instructors and their professional work in preparing for this event.

2.30 After analysing the results of the Course/Workshop on Airspace Design for the CAR/SAM Regions, the Meeting deemed it convenient to complete the training of the States of the SAM Region, taking into account that not all of the member States of the Project could attend this Course/Workshop. Also, the Meeting was of the opinion that it would be relevant to continue this process of support to the States in the redesign of its TMA with the PBN application.

2.31 With reference to the above, the Meeting agreed to formulate the following conclusion:

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:

a) 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

b) 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.

Action Plan for the South American Airspace Optimization

2.32 The Meeting analysed the action plan for the ATS Routes network optimization of the South American Region and deemed it convenient to make the following amendments:

a) Change the name to South American Action Plan for the Airspace Optimization, with the purpose to include the new tasks related to the main South America´s TMAs;

b) Include new tasks related to the optimization of the South American TMAs;

c) Include tasks related to the training of the human resources associated to the airspace optimization; and

d) Delete tasks that are not pertinent.

2.33 When analyzing the item related to the flexible use of airspace, the Meeting concluded that this item should be excluded from the South American Airspace Optimization Action Plan and that it should be a permanent task for the States, using the Guidance for the implementation of the Concept of the Flexible Use of the Airspace in the SAM Region, approved during SAM/IG/10. In this sense, the Meeting formulated the following conclusion:

Conclusion SAM/IG/11-2 Implementation of the the Concept of the Flexible Use of the Airspace in the SAM Region

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.

2.34 Based on the above, the Meeting approved the new Action Plan for the South American Airspace Optimization, shown in **Appendix B** to this part of the report.

Optimization of the Argentinian airspace

2.35 The Meeting took note that ANAC and the DGCTA were working with MITRE on a project to modernize the ATM system, which includes the redesign of the BAIRES TMA.

2.36 In the BAIRES TMA redesign project, MITRE submitted a set of basic criteria for organizing air traffic, dividing the BAIRES TMA airspace into dedicated incoming or outgoing sectors, known as “four corners” (four outgoing sectors and four incoming sectors).

2.37 Based on the above, the DGCTA submitted to ANAC a route modernization project that incorporated the requests made by ICAO and the redesign of the BAIRES TMA, taking into account all the quadrants of the new TMA except the one bordering with Uruguay, which would be the object of initial coordination efforts by MITRE with the Uruguayan authorities.

2.38 The DGCTA project took into account the factors mentioned in the previous paragraphs with a view to optimizing the route network, incorporating the redesign of the BAIRES TMA and safe management of incoming and outgoing traffic flows of the BAIRES TMA. Accordingly, the following was established:

1) In the BAIRES TMA, the SNT VOR/DME and the TORUL reporting point were established as entry points, and the GBE VOR and the ASADA and BIVAM reporting points as exit points.

2) Outside the BAIRES TMA, the ROS VOR/DME and PAR VOR/DME as points of concentration and deviation of traffic flows, allowing for aircraft sequencing.

3) The realignment of the existing route network and the design of other new routes in function of item 1), also taking into account lateral separation minima and the requests of the operators.

2.39 In view of the foregoing, **Appendix C** to this part of the report shows the routes proposed by the DGCTA, which were assessed together with the *Administración Nacional de Aviación Civil* (ANAC), taking into account the BAIRES TMA redesign project presented by MITRE and the request for new routes presented by LAN Argentina.

2.40 **Appendix D** to this part of the report contains a graph of the BAIRES TMA redesign project presented by MITRE to ANAC and DGCTA, containing the “four corner” model for the cited terminal.

2.41 **Appendix E** to this part of the report contains the initial proposal of the DGCTA, which was assessed jointly with ANAC, within the framework of the BAIRES TMA redesign project presented by MITRE.

2.42 Finally, under this route modernization project, ANAC and the DGCTA have foreseen to address this issue within the framework of bilateral meetings to be held between the affected countries.

APPENDIX A / APÉNDICE A

Planilla de Rutas analizadas en la Región SAM
Table of SAM Region routes analysed

XX	**Guayaquil-Madrid (Bidireccional)**	
Ruta actual /Current route (FliteStar)	**NUEVA RUTA**	**Notas/Notes**
Distancia actual Current distance	4897 NM	
*Número de vuelos mensuales *Number of monthly flights	120 vuelos LATAM	
*Tipo de aeronave más utilizada *Type of most used aircraft	B767, B777	
Trayectoria propuesta Trajectory proposed	BIVAN-ILVIR-AMAYA-EGOSU-DAREK	**BIVAN 01°34´08´´S-79°30´´13´´W ILVIR 03°50´32´´N-071°17´35´´W AMAYA 06°09'48"N-068°09'30"W EGOSU 07°57'57"N-066°08'44"W DAREK 11°29'39"N-062°48'14"W**
Distancia de trayectoria propuesta Distance of proposedtrajectory	4872 NM	
Millas reducidas Reduced miles	**25 NM**	
Reducción de Combustible/ CO_2 aproximado Fuel Savings / approximate CO_2	**1364 Tn**	
Estados involucrados States involved	Ecuador-Colombia-Venezuala	LIM FIR ECUADOR-COLOMBIA N 00 15 51 W076 57 21 LIM FIR COLOMBIA-VENEZUELA N 06 09 33 W068 42 19 LIM FIR VENEZUELA-PIARCO N 11 29 54 W062 48 24
Observaciones Remarks	Esta ruta se corresponde con la solicitadapor LATAM / This route corresponds to the route requested by LAN	
*De acuerdo a información disponible/As per availableinformation		
Esta ruta atiende un flujo importante de operaciones , por lo que sería importante implantar una ruta directa. Solo se consideran los vuelos de LATAM / This route serves an important flow of operations, for which it would be important to implement a direct route. Only LAN flights are considered.		

APPENDIX B (revised ~~24/04/13~~17/05/13)

ACTION PLAN FOR THE OPTIMIZATION OF THE ~~ATS ROUTE NETWORK OF THE~~ SOUTH AMERICAN ~~REGION~~ AIRSPACE
(~~GPIs 1, 5, 7, 8, 10, 11~~B0-5, B0-10, B0-20, B0-65)

Activity	Start	End	Responsible party	Observations
~~1. **First Phase – RNAV-5 implementation - COMPLETED**~~				
~~2. **Second Phase – Implementation of Version 1 of the SAM ATS Route Network - COMPLETED**~~				
~~3.~~1. ~~**Third Phase –**~~ **Implementation of Version 2 of the SAM ATS Route Network / PBN implementation of main South American TMA**				
Activity	**Start**	**End**	**Responsible party**	**Observations**
~~3.1. **Flexible use of airspace**~~				
~~3.1.1. Establish a civil-military coordination committee to assess the application of the Flexible Use of Airspace concept cited in 3.1.1.~~	~~SAM/IG/7~~	~~SAM/IG/11~~	~~States~~	~~Civil-military committees must be implemented in those States that have not done it yet. Civil/Military Coordination Meeting/ Workshop held on 16-19 August 2011.~~
~~3.1.2. Develop route implementation and/or realignment proposals based on the application of FUA~~	~~SAM/IG/7~~	~~SAM/IG/11~~	~~States~~	
~~3.2.~~ **1.1 Airspace concept**				
~~3.2.1.~~ 1.1.1 Collect traffic data to understand traffic flows. ~~in the upper airspace~~.	SAM/IG/~~9~~11	~~30 Sep 2012~~TBD	SAM/PBN/IG (Project RLA/06/901) States	The Secretariat sent a State letter: Response date: September ~~2012~~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.
1.1.2 TMA				
1.1.2.1 Establish a *support team* to assist a group of States aligned in traffic flows and develop a base design for the main TMA in the SAM Region.	May 2013	SAM/IG/12	RLA/06/901 Project SAM Regional Office States	
1.1.2.2 Establish a work plan for the support teams, based on the traffic flows.	May 2013	SAM/IG/12	Project RLA/06/901 SAM Regional Office States	
1.1.2.3 Detail the planning of the optimization of the main SAM Region TMA, taking into account the base design developed together with the support team, defining among other relevant aspects, the gateways of the main TMAs of the SAM Region.	SAM/IG/12	SAM/IG/14	States	
~~3.2.2.~~1.1.3 ~~Define the gateways of the main TMAs of the SAM Region~~ SAM routes network.	~~SAM/IG/7~~	~~SAM/IG/11~~	~~States~~	~~States that have not yet restructured the terminal area shall submit the information at the SAM/IG/11 meeting.~~
~~3.2.3. Update the Letters of Agreement and Contingency with adjacent States.~~		~~SAM/IG/12~~	~~States~~	
~~3.2.4.~~ 1.1.3.1 Conduct a detailed study of the SAM ATS route network, with a view to preparing version 2 of the route network, including: • Identification of the tools required for conducting the study mentioned in 3.2.5	SAM/IG/7	~~SAM/IG/9~~ ~~SAM/IG/11~~SAM/IG/14	SAM/PBN/IG (Project RLA/06/901)	Two experts were hired for a period of 3 weeks on the second half of February 2012. The first part has been completed.

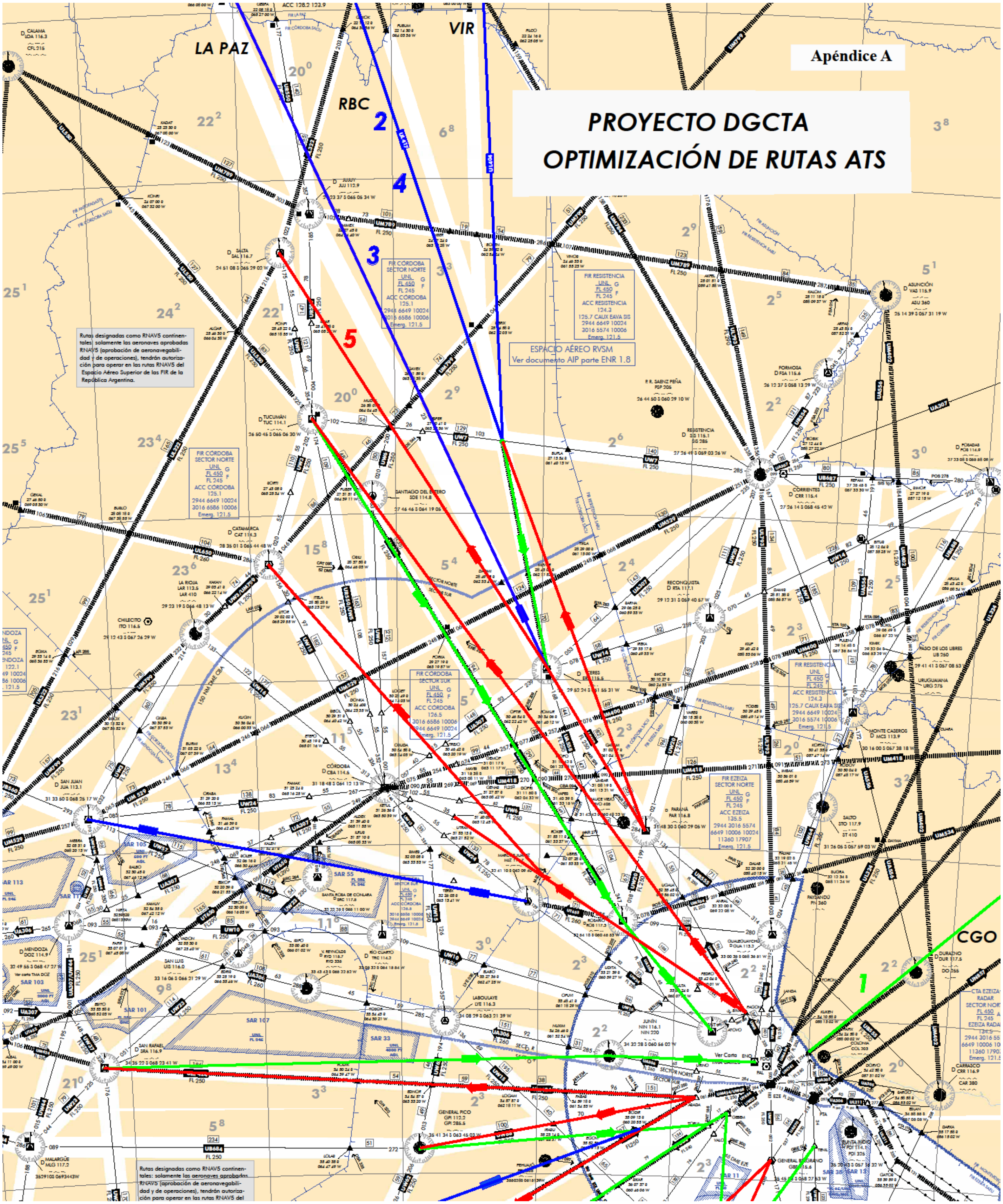
(aeronautical charts, specific software) • Definition of SAM airspace structure scenarios, including ATS routes, control sectors, TMA interface, for assessment using “airspace modelling” and fast-time ATC simulation tools. • Identification of ATS routes that should be eliminated, based on their utilization. • Proposal, if necessary, of the extent of the exclusionary airspace volume where RNAV-5 is to be applied. • If necessary, identification of the “conventional” ATS routes that should be eliminated or replaced with RNAV routes, based on the possible extent of the exclusionary RNAV-5 airspace. • Identification of RNAV routes that should be re-aligned, based on possible modifications to the gateways of the main SAM TMAs. • Description of possible scenarios for version 2 of the SAM route network and control sectors based on the analysis of the aforementioned items. • 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. • Based on traffic data, analysis of the possibility of implementing RNAV-5 parallel routes with adequate separation. • 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).				The first draft was developed for review by States and operators, and support was requested from the Project to continue working on the Optimization Study, with the engagement of a second period of 3 weeks and 2 experts before March 2013, based on new traffic data collected in August 2012, the feasibility studies conducted by States, and any modified TMAs in the Region. This task has not been fulfilled due to failure of States to send their data in August. SAM/IG and ATS/RO meetings have reviewed and modified the first draft, and the deadline for its definition has been set to the SAM/IG/11 meeting. The restructuring of routes, Phase 3, version 2, will be carried out by ATS/RO meetings.

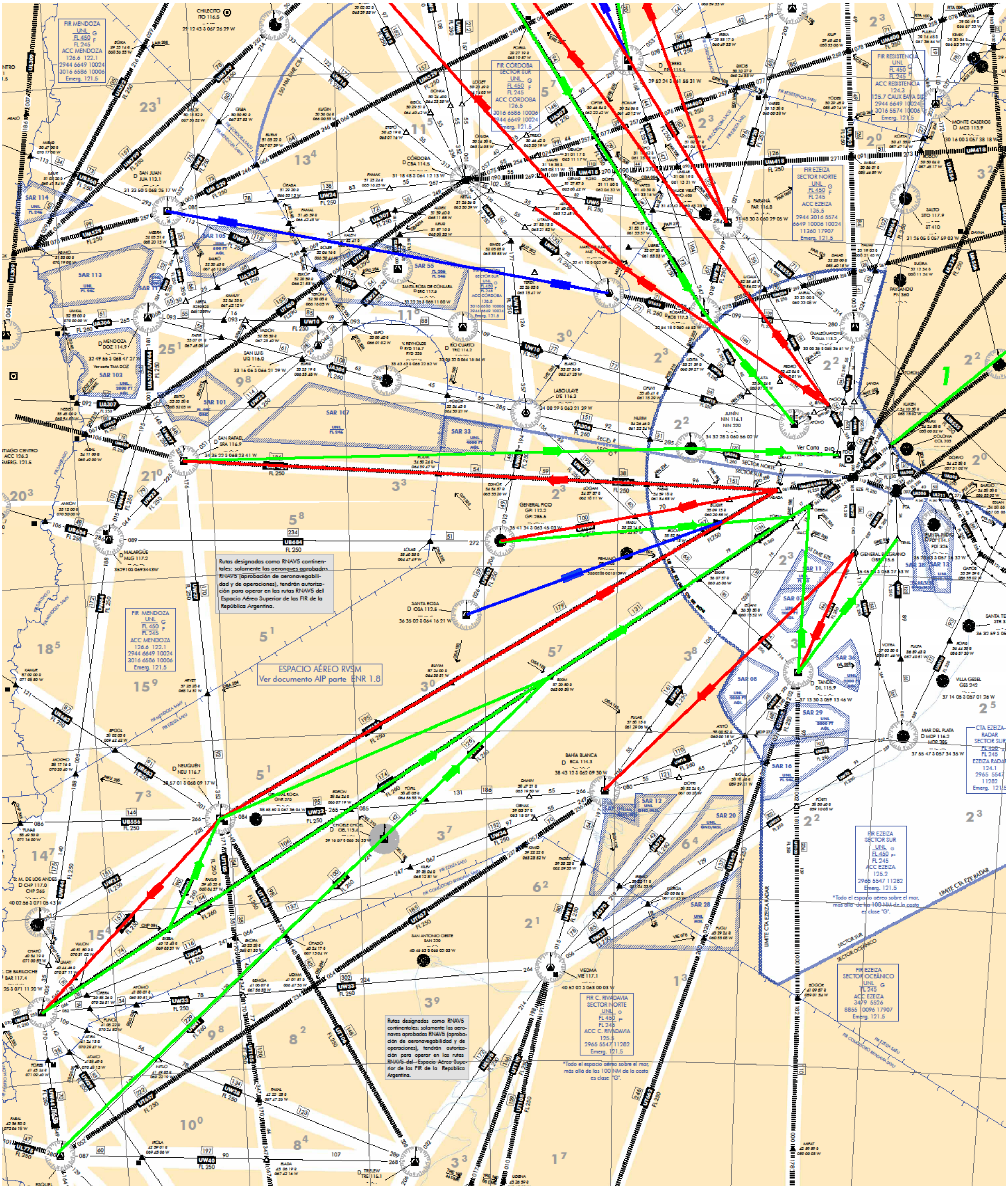
• Development of a plan for the optimization of restricted, prohibited, danger, and reserved use areas of the SAM Region. • Application of CDO techniques. • Develop implementation proposals and/or route realignments, taking into account the FUA Manual approved by the SAM/IG/XX. • Establish the most appropriate navigation specification. • Develop a plan to measure performance, including gas emissions, safety, efficiency, etc.				
3.2.5. 1.1.3.2 Conduct "Airspace Modelling" and fast-time simulation studies to assess the scenarios developed under 3.2.3.25	July 2013	SAM/IG/152	Project RLA/06/901 States	The Secretariat inquires about using the tool available in Brazil. If this is possible, procure, through Project RLA/06/901, the participation of 2 experts from the States of the Region. It has not been possible to use the tool due to availability issues.
1.1.3.3 Conduct the Fifth Workshop/Meeting for the Optimization of the SAM ATS Route Network (SAM ATSRO/5), for the purpose of reviewing and validating the studies mentioned in 3.2.6 and 3.2.7.	SAM/IG/10	July 2013	Project RLA/06/901 States	This meeting will also take care of Phase 3, Version 2, of the ATSRO Programmearrange for a route package selected by the users and States.
1.1.21.1.4 Training				
3.2.6. 1.1.4.1 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. and DECEA (Brazil). The Secretariat should send a

				~~letter to DECEA requesting two instructors.~~ The purpose is to train airspace planners of the States of the Region ~~on the 2nd half of April 2012 in Lima~~. 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.
~~3.2.7.~~ 1.1.4.2 Replicate Seminar/Workshop/Work Meeting on Airspace Planning in the SAM Region.	May 2013	Nov 2013	RLA/06/901 Project States	Objective: Complete the training of experts of SAM States, taking into account that not all States participating in the Project could attend the Course/Workshop held in

				Miami
1.1.3 1.1.4.3 Basic PANS/OPS Procedure Design Course.	May 2013	Nov 2013	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
1.1.4 1.1.5 Safety assessment				
3.2.8. 1.1.5.1 Prepare the required safety assessment, applying a qualitative methodology using the SMS.	31/07/12	SAM/IG/10 SAM/IG/11	Project RLA/06/901 States	An expert needs to be hired for 2 weeks to carry out this task. (This task has been completed.) The following task is still pending: States shall conduct a safety analysis of changes in their terminal areas (TMAs).
3.2.9. 1.1.5.2 Conduct the third Workshop/Seminar/Meeting on risk analysis of Version 2 of the SAM ATS route network. Validation of study in 3.2.7.	September 2012	SAM/IG/11	RLA/06/901 Project States	COMPLETED
3.2.10. Conduct the Third Workshop/Seminar/Meeting for conducting the risk analysis of version 2 of the SAM ATS route network. Validation of the study described in item 3.2.7.	September 2012	SAM/IG/11	Project RLA/06/901 States	COMPLETED
3.3.1.2 **Implementation of Version 2 of the SAM ATS Route Network**				
3.3.1. 1.2.1 Process the proposal of amendment to the CAR/SAM Air Navigation Plan.	August 2013		SAM Regional Office	The date must be adjusted.

~~3.3.2.~~1.2.2 Publish version 2 of the SAM ATS Route Network.	~~22 August 2013~~	States	The date must be adjusted.
~~3.3.3.~~1.2.3 Entry into effect of version 2 of the SAM ATS Route Network or a segment of the route package as per the SAM/IG/10 report, Item 2.5.	~~17 October 2013~~		The date must be adjusted.


Apéndice A
PROYECTO DGCTA
OPTIMIZACIÓN DE RUTAS ATS
LA PAZ
VIR
RBC
CGO
ESPACIO AÉREO RVSM
Ver documento AIP parte ENR 1.8
Rutas designadas como RNAV5 continentales: solamente las aeronaves aprobadas RNAV5 (aprobación de aeronavegabilidad y de operaciones), tendrán autorización para operar en las rutas RNAV5 del Espacio Aéreo Superior de los FIR de la República Argentina.


FIR MENDOZA
FIR CÓRDOBA SECTOR SUR
FIR RESISTENCIA
FIR EZEIZA SECTOR NORTE
FIR EZEIZA SECTOR SUR
FIR EZEIZA SECTOR OCEÁNICO
FIR C. RIVADAVIA SECTOR NORTE
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Rutas designadas como RNAV5 continentales: solamente las aeronaves aprobadas RNAV5 (aprobación de aeronavegabilidad y de operaciones), tendrán autorización para operar en las rutas RNAV5 del Espacio Aéreo Superior de las FIR de la República Argentina.
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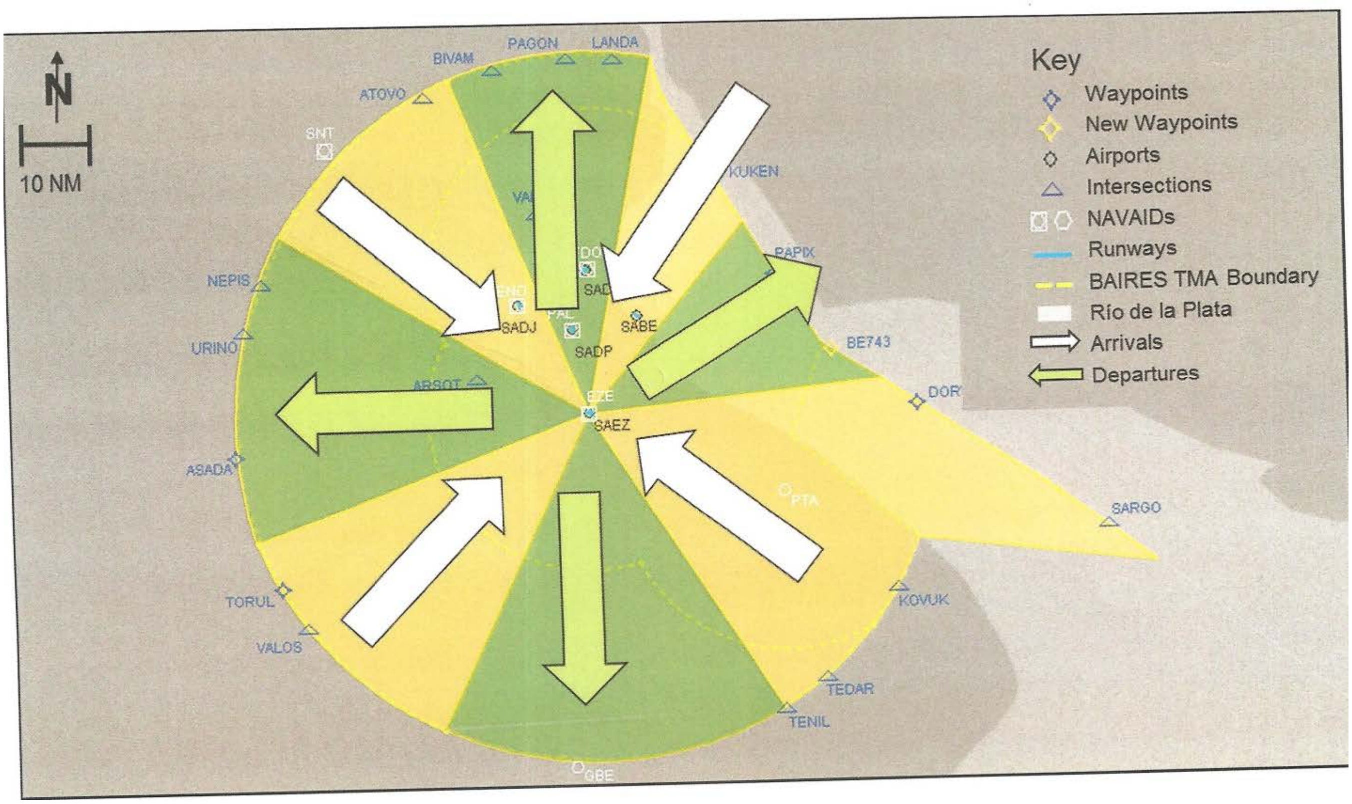
LÍMITE CTA EZEIZA RADAR

APPENDIX E


N
10 NM
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Runways
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Arrivals
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ATOVO
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URINO
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VALOS
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GBE

Agenda Item 3: Implementation of performance-based navigation (PBN) in the SAM Region

Follow-up on activities of Project A1 - PBN operational implementation

3.1 The Meeting recalled that, with a view to the implementation of performance-based regional plans pursuant to the Global Air Navigation Plan and the Global ATM Operational Concept, the GREPECAS/16 meeting approved the modification of the GREPECAS structure. In this sense, it eliminated the AERMET, AGA/AOP, AIM and CNS/ATM Subgroups and their respective Task Forces, converting the work programmes and terms of reference of those subgroups into Programmes and Projects. Accordingly, it formulated Decisions 16/45 and 16/47.

3.2 The *"Performance-Based Navigation (PBN)"* programme has the following associated projects:

a) PBN operational implementation; and
b) Air navigation systems in support of PBN (CNS infrastructure)

3.3 Project A1, which deals with PBN Operational Implementation, included not only PBN implementation but also the optimization of the upper airspace route network, with a view to establishing new RNAV routes or realigning existing RNAV routes, replacing or eliminating conventional routes whose paths coincide or are similar to the proposed RNAV routes or which are not being used by users. Given the scope of this programme, a high level of commitment is required from all stakeholders, whether commercial, military, general aviation, service providers and aeronautical authorities.

3.4 Nevertheless, the Meeting considered that Project A1 should be finalized, and its activities should be included in the Programme Optimization of the South American Airspace, taking into account that:

a) There is repetition in the Project A1 and in the Programme Optimization of the South American Airspace tasks;
b) The operational benefits are related with airspace optimization and not to the application of PBN navigation specifications; and
c) PBN should be considered as a tool in the optimization of the South American airspace process.

Status of implementation of ICAO Assembly Resolution A37-11

3.5 The Meeting recalled the importance of following-up on the status of implementation of ICAO Assembly Resolution A37/11, particularly with regard to the implementation of vertical guide approach procedures, which in 2014 should reach to 70% of the thresholds with IFR operations. In this sense, the Secretariat informed it had sent a survey to the SAM States, through letter SA204 with target date for reply 8 May 2013. To date, only three States had replied to the survey. In this manner, the Meeting was of the opinion that States should answer the survey in **Appendix A** to this part of the report as soon as possible, and no later than 30 June 2013.

PBN airspace

3.6 LAN Chile presented a working paper indicating it was an honour and a pleasant experience to participate in the Course/Workshop on Airspace Design, which has heightened the interest and conviction of the organisation in the notion that there is still much to be done and many opportunities for improvement awaiting implementation, especially in the TMA setting, since much has already been done en-route.

3.7 During the Workshop on PBN Airspace, LAN Chile informed that thanks to the brilliant presentations made by the highly qualified instructors, it was possible to reflect upon, and exchange ideas about the many topics related to PBN implementation in TMAs that are so important for operators, and which should be highlighted and shared:

a) **Joint participation:** it is fundamental to take into account the opinion and experience of all the parties in order to achieve the best results. The designers, ATC and operators always have something to contribute in a successful implementation. In many countries, working groups that include regulators, ANSPs and operators have already been established to jointly develop tasks and concepts;

b) **Controlled airspace volumes:** Due to the establishment of new paths using PBN SIDs and STARs, it is necessary to reconsider the extent of TMAs and controlled airspace required to accommodate the new procedures. The TMA must be adjusted to the new paths and procedures and not the other way around, so as to obtain as many optimum descent and climb profiles as possible to accommodate the different types of FMS systems and performance of the aircraft considered in the implementation;

c) **Radar sector minima:** there are radar minimum charts that have not been modified for a long time and which could be revised to give more consistency to the new paths likely to be published, especially in the case of RNP AR APCH which, many times, is applied in areas not previously contemplated (see example in **Appendix B** to this part of the Report);

d) **Location of holdings:** from the point of view of fuel efficiency, it is very important that holdings be always planned at more than 8000 FT (*e.g.*, an A320 burns 2153Kg/hr in a HLDG at 5000 ft and 2026Kg/hr at 20000 ft);

e) **AIRAC cycles:** since PBN procedures can only be flown from the Navigation Database (NavDB), it is fundamental to respect AIRAC cycles and publish the charts duly in advance so that the new procedures may be included in the NavDB;

f) **Increase available airspace:** many times, the TMA contains airspaces that are not used or are underutilised, in which, prior to PBN, it had not been possible to implement conventional instrument procedures. It is important to analyse such airspaces with PBN in mind, to see if there is any possibility of introducing improvements to increase their capacity (see example in **Appendix C** to this part of the Report);

g) **Revise existing descent profiles for CDO implementation purposes:** even if a PBN arrival path is laterally similar to the existing conventional one, it is now possible to improve descent profiles using RNAV1 and RNP1 protection areas, in order to obtain operational benefits related to CDO implementation. Many times, these areas are much smaller and make it possible to disregard obstacles that result in demanding profiles in mountainous areas. The descent in the more modern aircraft is less than 3°, in many cases close to 2° (see example in **Appendix D** to this part of the Report); and

h) **Navigation database capacity:** there is no doubt that the implementation of the new PBN procedures is providing many benefits to users. However, a limitation must be considered: the capacity of many navigation databases, especially the older ones, is being exceeded by the publication of these new procedures, since the FMS was not designed to accommodate the sustained growth of procedures and airways at the rate at which they are being published worldwide. Consequently, a fundamental task for States and air traffic services is to eliminate from the publications those procedures no longer being used and/or that not even serve as backup for the structure normally used in a TMA. As an example, the storage capacity of a Legacy B767 of the 90s is only 400KB, a modern A320 has 20MB, the A380 has 30MB, and future developments speak of 100MB, much less than what one might imagine.

3.8 With regard to the afore mentioned, the Meeting deemed fundamental to become aware of the following manuals involved in the design of the PBN airspace:

a) ICAO Doc 9613 – Performance Based Navigation (PBN) Manual;
b) ICAO Doc 9992 – Manual on the use of performance based navigation (PBN) in airspace design;
c) ICAO Doc 9931 – Continuous descent operations (CDO) Manual; and
d) ICAO Doc 9993 – Continuous climb operations (CCO) Manual.

Basic PANS-OPS course for the SAM Region in Ecuador

3.9 The Meeting took note that the Administration of Ecuador has made a huge effort to join Project RLA/06/901, which was recently completed, thus contributing to a harmonised implementation in the SAM Region.

3.10 The Meeting recognized that one of the main problems facing some administrations in the Region is the natural turnover of aeronautical experts, which poses a challenge in terms of training the personnel that will be responsible for the implementation of the Action Plans developed by the regional implementation groups.

3.11 In this sense, the Meeting has identified in most States of the SAM Region a significant lack of training of experts on topics such as Basic Procedure Design, PBN Procedure Design, and Terminal Area Design, to address PBN implementation.

3.12 Recognising that Project RLA/06/901 is a great tool, Ecuador has submitted to the Meeting the urgent need to start providing training in Basic Procedure Design and then continue with the other PBN procedure design courses and, in this sense, propose some regional cooperation schemes.

3.13 For the conduction of a Basic PANS-OPS Procedure Design Course, Ecuador has offered its training facilities in the city of Quito to all Project participants, as well as providing 2 assistant instructors, since no senior instructor is currently available in Ecuador.

3.14 As a counterpart, Ecuador has requested the following support from Project RLA/06/901:

a) drafting of material for the Basic Procedure Design Training Course (PANS-OPS); and
b) provision of a qualified senior instructor to conduct the course.

3.15 Other Project member States who need to train their personnel in basic PANS-OPS procedure design could also participate in this Basic PANS-OPS Procedure Design Course. Given the urgent nature of this matter, it is felt that this action should be included in the Project Schedule for this year, as an additional task, or in replacement of any other task that has not been implemented.

3.16 With regard to the above, the Meeting agreed to formulate the following Conclusion:

Conclusion SAM/IG/11-3 Basic PANS-OPS Course

That, RLA/06/901 Project evaluates the feasibility to:

a) consider the request of Ecuador for the conduction of a Basic PANS-OPS Procedure Design Course in Quito, taking into account said State would cover 50% of the cost, and provide 2 assistant instructors;
b) study the possibility of obtaining financial support from Project RLA/06/901 for hiring a senior instructor and drafting training material;
c) study the possibility of including this task in the implementation programme for this year, in replacement of some task that has not been implemented, using the "fast-track" mechanism of the Project; and
d) consider the need to include training courses on PBN approaches in the Project Programme, taking into account training gaps in the Region.

3.17 Taking into account that Argentina also currently faces the same problems as Ecuador, the Argentinean delegation has also suggested the holding of a basic PANS-OPS course, under the same model as in Conclusion SAM/IG/11-3. This course would be supported by LAN Argentina and Aerolineas Argentinas.

3.18 After discussing the need for a PANS-OPS course for the SAM Region, the Meeting was of the opinion that without training in this area, there could be no progress in PBN implementation. The Meeting recalled that RLA/06/901 Project had already provided its participants with RNAV PANS-OPS and RNP AR courses. Nevertheless, these experts would already be involved in other activities and were unavailable to develop instrumental procedures. In this sense, the Meeting considered important establishing an appropriate profile for the future PANS-OPS experts, including that there is guaranteed that the expert be kept in this activity for a certain period of time.

3.19 In this sense, the Meeting concluded that, in addition to the initiatives for the training of human resources in the PANS-OPS area, States should guarantee that the PANS-OPS experts are kept in this activity, taking into account its critical status for the optimization of the airspace and to achieve the potential benefits of PBN implementation.

3.20 The Meeting recommended that the PANS-OPS training subject be dealt with as a specific project within the SAM Regional Office, through the use of project management techniques, with the aim of obtaining the resources necessary for this training, including from some airlines, who have offered their support in these activities.

3.21 The Meeting indicated that during the airspace design process, which will count with the support of the regional PBN support team and that will include the experts in the areas involved in the airspace optimization, support will be obtained for the design of instrument procedures, through the airlines interested in the project.

RNP AR operations

3.22 The Meeting noted that since its publication, ICAO Doc 9613, PBN Manual, has become the main document of reference and consultation for implementation of performance-based navigation worldwide. The wide range of topics it contains and the possibility of providing clear and concise guidance on different topics to regulators, air traffic service providers, and operators have given huge added value to this material delivered by ICAO.

3.23 The Meeting took note of the new edition of the PBN Manual published by ICAO, and believed it was important to draw some aspects concerning the implementation of RNP AR approaches to the attention of those involved in these processes.

3.24 In general, RNP AR approaches have been seen as a method to approach geographically challenging locations. There are many examples of runways confined by hilly terrain and lacking instrument procedures that have been provided with RNP AP procedures. They are models to follow, especially in our region, which is crossed from north to south by the Andes mountain range.

3.25 Notwithstanding, for an RNP AR operator that has invested in aircraft equipage and crew training with a high level of complexity, it is desirable to obtain all the benefits offered by this type of approaches, including the possibility of shorter IMC approach paths, similar to VMC, through the implementation of visual approaches that, in many cases, avoid deviations of 10 to 15 NM to go back to the published instrument approach.

3.26 An RNP AR approach can be highly effective, reducing the flight path through the incorporation of RF segments in all approach segments, including vertical guidance in the final segment. Accordingly, the new edition of the PBN Manual, Chapter 6, Vol. II "Implementing RNP AR APCH" now reads: "*6.1.1.1 The RNP AR APCH specification represents the ICAO global standard for developing instrument approach procedures to airports where limiting obstacles exist and/or where significant operational efficiencies can be gained"*, which reflects a change of vision in the use and potential implementation of this type of approach in terminals where traffic and aircraft equipage make it feasible and where complicated natural obstacles do not exist.

3.27 Likewise, the Meeting recognized that the operational approval requirements for this type of approach are somewhat different now, depending on the State where it is conducted. A key notion of PBN implementation is the certification of activities and requirements so that operators will apply similar processes, regardless of the State where they take place. Apparently, the guidance for the issuance of an RNP AR approval to an operator has been understood with different nuances.

3.28 The Meeting noted that the new edition of the PBN Manual explains the spirit of the approval, stating: *"6.3.2.2 Any operator with an appropriate operational approval may conduct RNP AR APCH instrument approach procedures, in a similar manner that operators with the proper authorization may conduct CAT II and CAT III ILS operations. This authorization may be in the form of a single approval for all RNP AR APCH procedures within a State, separate approvals for each RNP AR APCH procedure, or a combination of these methods (for example, State-wide approval for all procedures except those in highly challenging operational environments"*, which means that each State can and must assess how and why shall it issue the approval in one way or other, depending on the characteristics of the operator and RNP AR procedures involved.

3.29 Thereafter, the Meeting took note of the need to become clear on the application of RNP AR APCH approval procedures and of harmonizing these procedures in the Region. In this regard, the Meeting commented that RNP AR APCH is generic for public procedures and that the requirement of the operational experience (number of approaches under visual conditions and with a minima line greater to that requested) that should accumulate an operator during provisional authorization, is global and not for each aerodrome or runway threshold, for which it was recommended to grant authorization of each type of aircraft and each operator. In spite of the above, the Meeting clarified that each State can demand additional operational experience requirements during the provisional authorization period, at the aerodromes it considers necessary, due to special requirements proper to the design of each procedure or to the terrain.

3.30 Finally, the Meeting requested information on the status of the advisory circulars (AC) developed by the Latin American Regional Safety Oversight Cooperation System (SRVSOP). In this regard, the Meeting noted that an AC is required to be amended, and three additional circulars to be developed since ICAO has recently published the fourth edition of Doc 9613 – Manual on Performance Based Navigation (PBN), which changed the denomination of the specification for basic RNP 1 navigation to only RNP 1, and promulgated the following additional specifications: *RNP 2, advanced RNP and RNP 0.3*. To develop this task, the Meeting indicated it will request Project RLA/99/901 to assign economical resources for the development and presentation of these CA at SAM/IG/12 meeting. In addition, the Meeting was informed that SRVSOP will dictate courses on approval procedures, including the new navigation specifications developed by ICAO in Doc 9613 – fourth edition.

Emission reduction as a result of RNP AR implementation

3.31 The Meeting recognized that one of the strategic objectives of ICAO is "Environmental protection and sustainable development of air transport", by "promoting a harmonised and economically feasible development of international civil aviation without *unduly* harming the environment". It is well known that a combination of ATM improvements and operational procedures by the companies result in significant opportunities for reducing emissions.

3.32 LAN Airlines indicated that since 2009 it has been implementing in Chile, together with the DGAC, an RNP AR procedure design and implementation programme at various airports and aerodromes of the country. The publication of these procedures has been aimed at obtaining improvements in terms of access (lower approach minima), safety (through the inclusion of procedures with vertical guidance that reduce CFIT occurrences) and emission reduction throughout the country, since RNP AR procedures permit shorter paths and optimised descent profiles that reduce fuel consumption and, thus, emissions.

3.33 There is no doubt that the implementation of the RNP AR project in Chile has been a joint effort by LAN Airlines and the DGAC that, in the near future, will benefit all operators who choose to equip and obtain the improvements that the new approaches can provide. Nothing of what has been achieved to date would have been possible without the commitment and thoroughness shown by both parties.

3.34 By March 2013, RNP AR procedures had been published for the airports of Iquique, Antofagasta, Calama, La Serena, Santiago, Temuco, Valdivia, Osorno, and Balmaceda; projects are being developed for Concepcion, Puerto Montt, and Punta Arenas.

3.35 Data captured by LAN during 2012 show that the RNP project of Chile reduced fuel consumption by 250 thousand gallons during that period of time, equivalent to 757 thousand kg of fuel, which, translated to CO2 correspond to 2.413 tons of CO2 not released into the atmosphere.

3.36 The results reflect the professionalism of LAN and the DGAC work teams involved in this effort from the point of the regulations, design, validation, publication and implementation of procedures, in addition to the collaboration of the ATC, which is now open to changes and is addressing them in the best possible way.

APÉNDICE A / APPENDIX A

ENCUESTA REGIONAL DE LOS PROCEDIMIENTOS DE APROXIMACIÓN, OPERACIONES EN TMA Y EN RUTA BASADOS EN LA PBN / REGIONAL SURVEYOF PBN-BASED APPROACH, TMA AND EN-ROUTE PROCEDURES

Informe de avance de la implantación de la PBN / PBN implementation progress report

Nota/Note: Basado en la Resolución A-37/11 de la Asamblea de la OACI y el Plan Regional SAM/ Based on ICAO Assembly Resolution A-37/11 and the SAM Regional Plan

<u>Designación de Puntos Focales PBN por Estado / Designation of PBN Focal Points per State</u>

Estado/Status:	(Nominado/a ser nominado**)** (Nominated/ To be Nominated)
Punto Focal / Focal Point:	(Nombre, Cargo, E-mail, teléfono, fax) (Name, Designation, Mailing Address, Email, Phone, Fax)

ANSP:

FECHA/DATE:

Completado por/Completed by:

EMAIL:

Puesto/Position:

Favor completar una encuesta para cada Aeropuerto Internacional/Please complete one survey for each International Airport

PROCEDIMIENTOS CONVENCIONALES/CONVENTIONAL PROCEDURES

NOMBRE AEROPUERTO/AIRPORT NAME:		**IDENT OACI/ICAO:**	
Tipo de procedimiento/ Type of procedure	**Implantado/ Implemented (Número/Number)**	**Planificado/ Planned (año/year)**	**Comentario/ Comment**
STAR CONVENCIONALES/ CONVENTIONAL STARs			
SID CONVENCIONALES/ CONVENTIONAL SIDs			
APROXIMACIONES VOR/ VOR APPROACH			
APROXIMACION NDB/ NDB APPROACH			
APROXIMACION ARCO DME/ DME ARC APPROACH			
APROXIMACION LOC/ LOC APPROACH			
APROXIMACION ILS/ ILS APPROACH			

OPERACIONES DE DESCENSO Y ASCENSO CONTÍNUO / CONTINUOUS DESCENT AND CLIMB OPERATIONS

NOMBRE AEROPUERTO/AIRPORT NAME:		IDENT OACI/ICAO:	
Tipo de operación/ Type of operation	**Implantado/ Implemented (Número/Number)**	**Planificado/ Planned (año/year)**	**Comentario/ Comment**
OPERACIONES DE DESCENSO CONTINUO/ CONTINUOS DESCENT OPERATIONS (CDO)			
OPERACIONES DE ASCENSO CONTINUO/ CONTINUOS CLIMB OPERATIONS (CCO)			

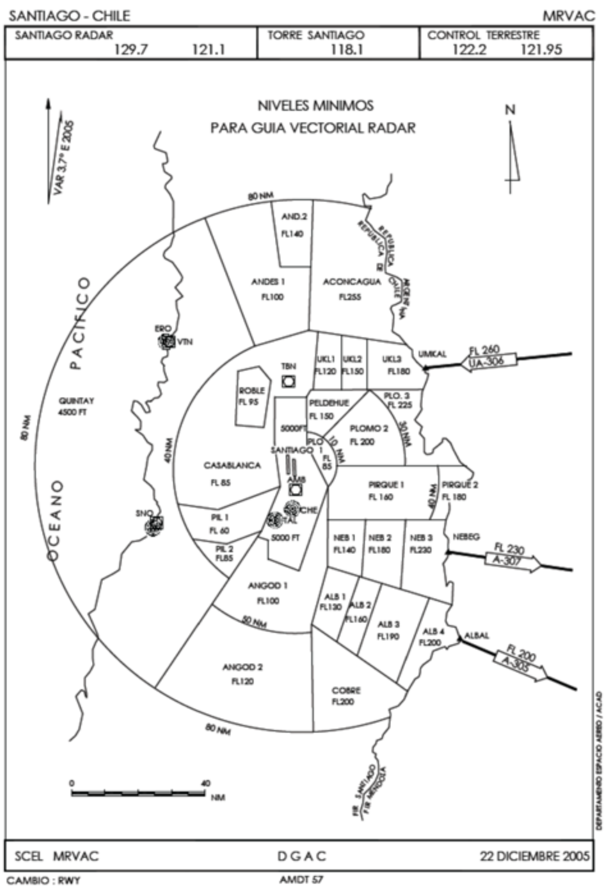
PROCEDIMIENTOS PBN/PBN PROCEDURES

NOMBRE AEROPUERTO/AIRPORT NAME:		IDENT OACI/ICAO:	
Tipo de procedimiento/ Type of procedure	**Implantado/ Implemented (Número/Number)**	**Planificado/ Planned (año/year)**	**Comentario/ Comment**
RNAV STARs			
RNP STARs			
RNAV SIDs			
RNP SIDs			
APROXIMACION BÁSICA GNSS RNAV/ BASIC GNSS RNAV APPROACH			
APROXIMACION RNP solo LNAV/ RNP APPROACH only LNAV			
APROXIMACION RNP con Baro VNAV/ RNP APROACH with Baro/VNAV			
APROXIMACION RNP AR/RNP AR APPROACH			
APROXIMACIONES GBAS / GBAS APPROACH			

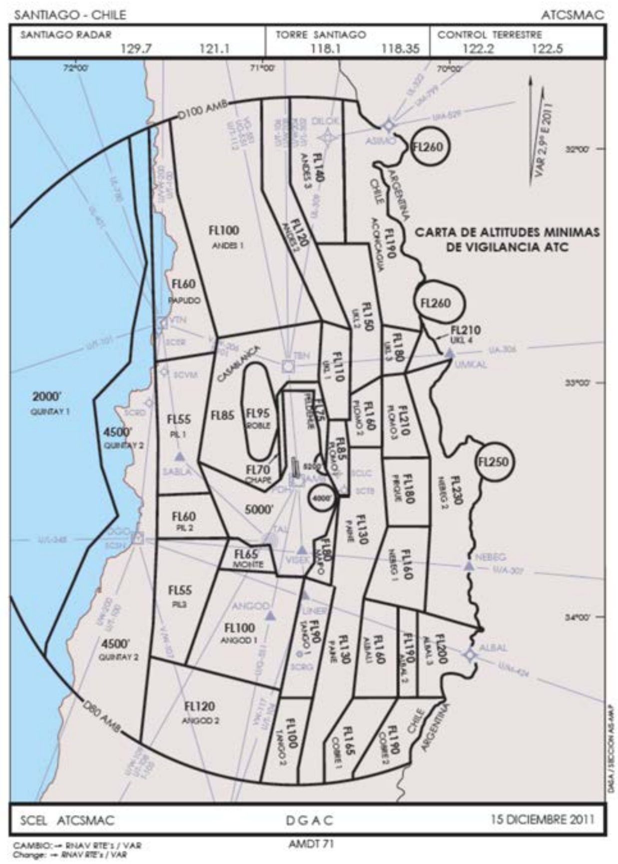
OPERACIONES EN RUTA / EN-ROUTE OPERATIONS

Especificaciones de Navegación/ Navigation Specification	Finalizado / Completed (Número de rutas/ Number of routes)		Implantación planificada / Planned implementation (Número de rutas/ Number of routes)	
	Domésticas/ Domestic	Internacionales / International	Domestic	International
RNAV 10				
RNAV 5				
RNAV 2				
RNP 4				
RNP 2				

APPENDIX B

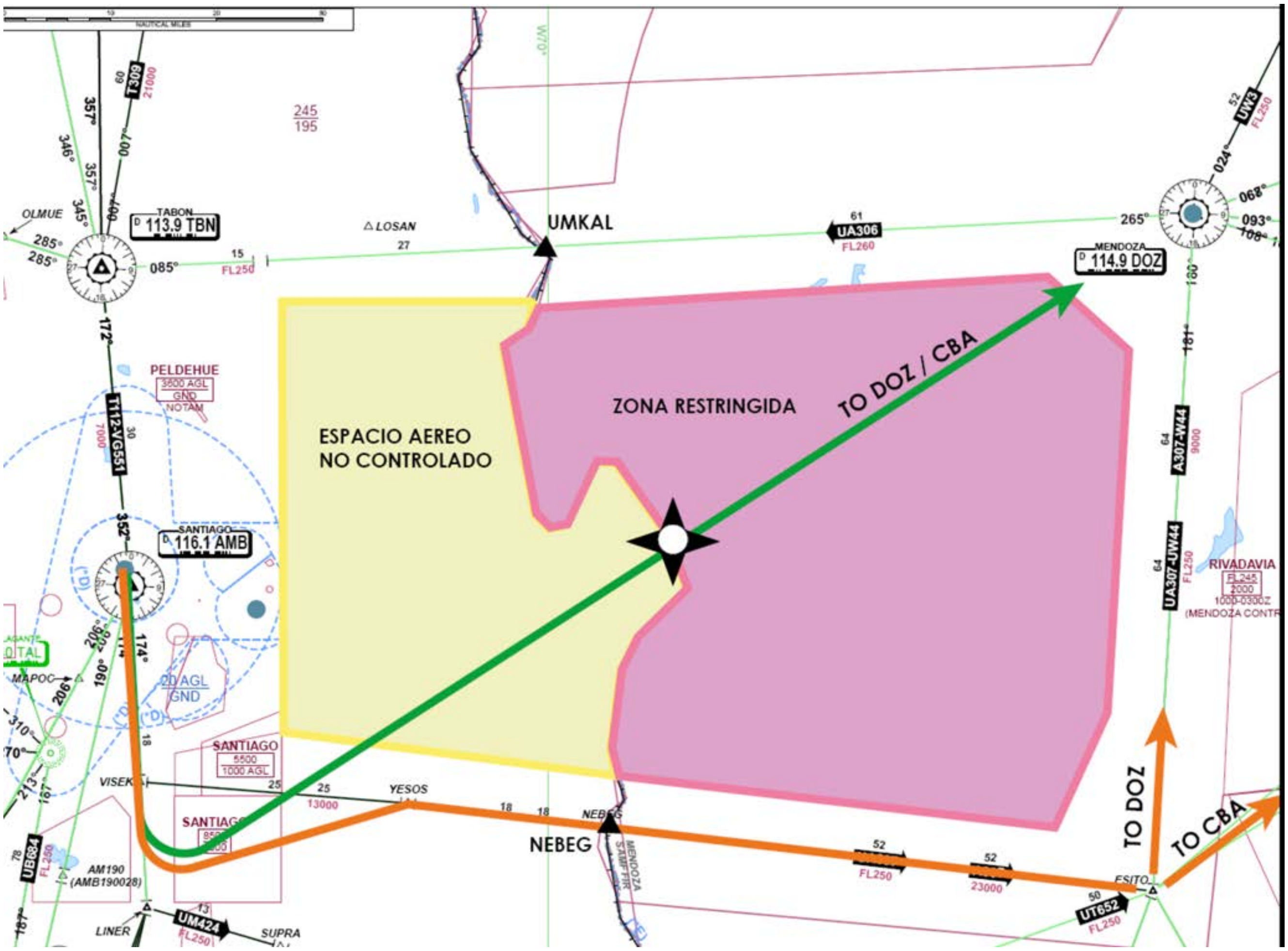


Old SCEL minima sector chart



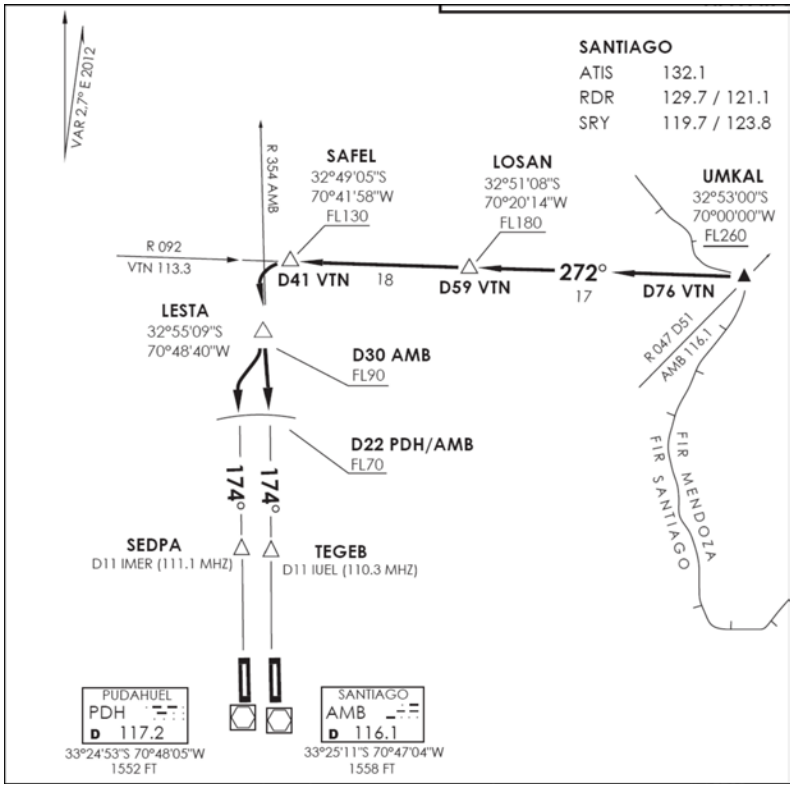
Revised sector minima chart improving specially sector ASIMO which was implemented to admit climb and descent from/to new RNAV regional AWYs that were published.

APPENDIX C

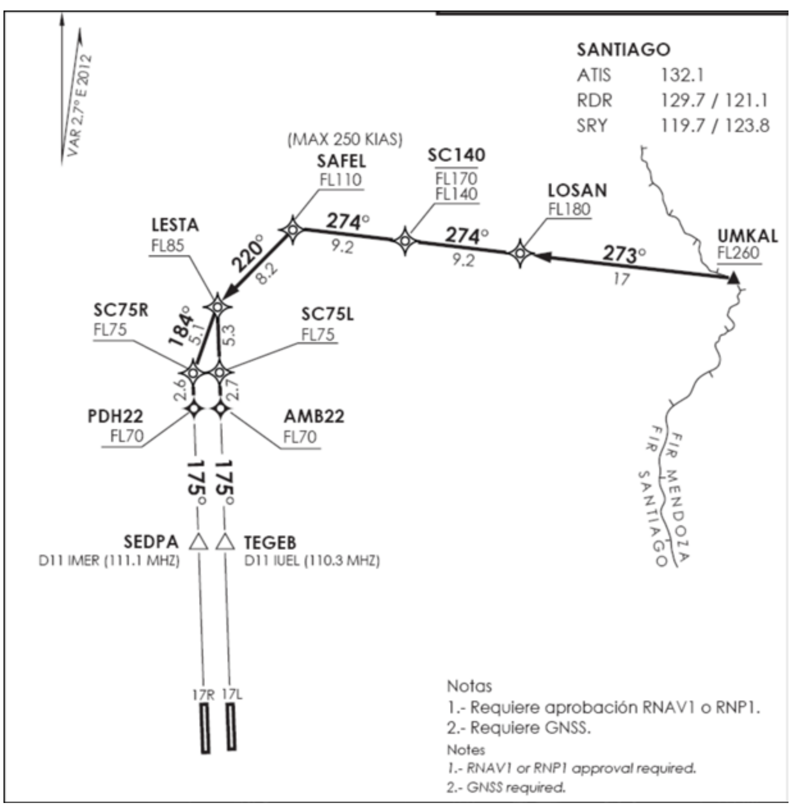


The crossing from SCEL to DOZ/CBA was always done based on ground aids, reason why the airspace between UMKAL and NEBEG was never used. Through a SID PBN and the flexible use of airspace, the possibility of a shorter and efficient route could be explored.

APPENDIX D



The crossing from Argentina is based on a VOR VTN radial; there is no lower AWY as the upper AWY has a FL260 MEA; Monte Aconcagua is located more than 10 Nm of UMKAL. If the Navaid is out of service, there is no AWY nor descent procedure available.



A STAR PBN provides Independence from ground aids, reduced protection areas and the possibility to improve descent profile. It is even feasible to cross UMKAL at a lower level (FL210 or FL230), as Monte Aconcagua does not penetrates the protection area.

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

Review of the ATFM action plan

4.1 The Meeting started by reviewing the ATFM Action Plan that contemplates tasks by the assigned responsible parties, with specified completion dates.

4.2 As a result of this review (see draft **Appendix A-1**), the Meeting recognised that ATFM implementation has been delayed for various reasons, as explained by the participating States. An analysis of the tasks in the plan and of other matters identified as essential in order to move forward with ATFM implementation in the SAM Region follows.

Calculation of runway and ATC sector capacity

4.3 On this matter, it was recalled that Project RLA/06/901, with the assistance of Brazil, conducted several training activities for calculating runway and ATC sector capacity.

4.4 In this regard, the Meeting considered that those States that had not done it yet should calculate runway and ATC sector capacity at their main airports, giving priority to those with significant traffic.

4.5 In order to establish a baseline, the status of runway and sector capacity calculations shall be assessed. To this end, the Meeting prepared a survey aimed at defining runway, apron and ATC sector capacities at the main airports and, if applicable, identifying the operational factors that affect capacity, personnel training to conduct this task, and whether or not units responsible for air traffic flow management have been established. The survey is attached as **Appendix A** to this part of the report.

Coordination with the ATM community

4.6 One aspect mentioned when discussing this item was the way of establishing the exchange of information between the States. In this sense, it was agreed that teleconferences would be conducted as a follow-up to the ATFM action plan in order to assist States that so require in the resolution of any difficulties that they might encounter during the task implementation process.

4.7 These teleconferences will be conducted applying the "*go-to-meeting*" tool of the Regional Office, and will take place on the first Monday of each month. The ATFM implementation group, through its rapporteur, will coordinate as necessary with the Regional Office.

Infrastructure and database

4.8 In this regard, the Meeting recognised that, although some States of the Region had made substantial progress in the implementation of ATFM, other had not started yet the activities or were in the initial stages.

4.9 Although infrastructure is a vital element, it is also acknowledged that its implementation will take place at a later phase. The SAM ATFM Roadmap will be reviewed and, if appropriate, the information corresponding to this matter will be updated.

4.10 An important aspect that was identified was that States should develop homogeneous and standard databases. In this regard, Brazil was requested to share its experience and, if possible, the basic format so that SAM States could analyse it and take action accordingly. This process could be analysed during monthly teleconferences and the initial results would be submitted at the SAM/IG/12 and the final results at the SAM/IG/13.

Policy, standards and procedures

4.11 Regarding this matter, the Meeting recognised that there is ICAO documentation on standards, policies and procedures, as well as regional guidance material containing useful information that could be used by the States to define their operational policies, standards and operational procedures. Amongst the regional guidance material, a revision could be made of the ATFM Operational Concept, the ATFM Roadmap, and the ATFM Manual.

4.12 It was deemed advisable for the ATFM Working Group to start preparing guides for the development of letters of agreement between ATFM units.

4.13 Also, the scheduled ATFM teleconferences would serve to begin the exchange of common situational awareness elements. The results of this task will be presented at the SAM/IG/12.

4.14 In order to provide new guidance to SAM States on the implementation of FMU/FMP, the Meeting agreed to review the SAM ATFM Roadmap, and to provide simple guidelines to be used by the States as reference material in their implementation programme. This revision could require an adjustment of the ATFM implementation programme, its action plans and regional guidance documents. This update will be submitted to the consideration of SAM/IG/12.

Training

4.15 During the discussion of this topic, the Meeting recalled that, following the course conducted in 2012 on train-the-trainers, the final evaluation was left pending. Only one State was certified.

4.16 In view of the above, the ICAO Regional Office is requested to continue the assessment process so that States may have certified instructors and thus start basic training for their personnel and for the ATM community in general.

4.17 At this point, Brazil offered SAM States that, subject to coordination, a technical internship could be provided at CGNA in Brazil in order to become aware of the activities being carried out by this ATFM management centre.

4.18 Finally, the survey to be sent to the States will contain questions on current and future ATFM course requirements.

ATFM focal points

4.19 Furthermore, the Meeting recognised that it would be necessary to update the list of focal points. To this end, the survey prepared invites the States to confirm or update their ATFM focal points. These focal points should be responsible for the follow-up to ATFM activities in the Region and the execution of tasks aimed at ATFM implementation in the SAM Region.

4.20 States are encouraged to continue holding weekly operational teleconferences. Those States that have not done so yet are invited to start this activity.

Website

4.21 The Meeting gave importance to the possibility of using the SAM Regional Office website for posting aspects related to ATFM and relevant technical documentation. In this regard, the Regional Office is requested to enable this activity.

Follow-up on activities of projects under the ATFM Programme

4.22 With respect to the *"Air traffic flow management"* Programme, the SAM/IG meetings have been analysing Project B1, *Improvement of the demand-capacity balance* and Project B2, *Flexible use of airspace.*

4.23 One of the main issues identified in the SAM Region by SAM/IG meetings has been the lack of personnel specifically devoted to ATFM activities and that individuals responsible for ATFM management in their State are involved in other functions, preventing continuity of the tasks related to this matter.

4.24 The Meeting decided to revise Projects B1 and B2 in light of the results of the survey shown in Appendix A.

Activities conducted for the implementation of ATFM in Paraguay

Background

4.25 In 2009 (after its participation at the SAM/IG/02 meeting held in November), Paraguay started the implementation of the ATFM system, participating in training courses on airport and ATC sector capacity calculation, ATFM and the use of the CDM concept, thus setting the foundation for the implementation of this requirement.

4.26 **ATFM organizational structure:** The new organizational chart and manual of functions of the *Dirección Nacional de Aeronáutica* (DINAC - National Directorate of Aeronautics) was approved, which contemplated the future air traffic flow management units in Paraguay. Approval was given to a Central Air Traffic Flow Unit (mainly responsible for the regulatory area), and two FMUs at the international airports of Asunción and Guaraní in Ciudad del Este (operational areas), respectively.

4.27 **Activities and documentation developed for the implementation**:

- ATFM Manual;
- CDM Manual;
- ATFM Roadmap for Paraguay;
- AIC supplements on the implementation of ATFM in Paraguay;
- Two airport capacity calculation trials at the SGAS and SGES airports in 2010 and 2011 (the capacity of the SGAS airport has been recently calculated and will become valid for purposes of officially declaring the actual capacity of that aerodrome in June 2013);
- Training related to ATFM implementation (SGAS and SGES); and

– Completion of the first stage of the training course on Data collection for calculating runway and ATC sector capacity (November/December 2012) for SGAS/FMU personnel, and at Minga Guazú for SGES/FMU personnel.

4.28 All the aforementioned documents have been harmonized with ICAO guides and recommendations and adjusted to the Regional Roadmap.

Identification of the main traffic flows in the Asunción FIR

4.29 The Meeting took note of the main traffic flows in the Asunción FIR with respect to overflights, departures and arrivals.

4.30 It should be noted that four (4) main traffic flows have been identified, mainly consisting of overflights (see **Appendix B**).

4.31 The **first** has routes affecting the **La Paz** and **Asunción FIRs** (UA321 + UL793-combined routes), taking into account the traffic volume registered in one (1) year.

4.32 The **second** traffic flow of importance in the Asunción FIR is with the **Curitiba FIR** (UM799), considering the same time period as in the sample.

4.33 The **third** significant flow identified corresponds to traffic with the adjacent **La Paz FIR** (UL793). It should be noted that the flow on this airway corresponds to UL 793 alone, independently from the flow in the combined segment between UA321 and UL 793.

4.34 The **fourth** flow identified (overflights) corresponds to traffic between the **Curitiba FIR** and the **Resistencia FIR** (UM402 + UA321-combined routes).

4.35 Likewise, four (4) main traffic flows (departures and arrivals) have been identified (see **Appendix C**), mainly with flights going to the **Asunción FIR** and the **Resistencia FIR**, and which use UA 556).

4.36 The **second** influential flow (departures and arrivals) in the **Asunción FIR** is with the **Curitiba FIR** (UM548).

4.37 The **third** significant flow identified (departures and arrivals) corresponds to traffic with the **La Paz FIR** (UA321).

4.38 The **last** flow identified (departures and arrivals) is traffic between the **Asunción FIR** and the **Curitiba FIR** (UM402).

4.39 Statistical data:

Overflight, departure and arrival routes most widely used in 2012

AWY	MONTHS												
Overflights	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**TOTALS**
UM799	156	138	166	153	147	152	171	151	145	141	127	152	1799
UM402/UA556	99	105	77	65	52	58	66	83	68	72	68	55	868
UA321/UL793	238	205	203	204	167	178	223	204	203	203	135	175	2338
UL793	101	82	88	140	128	98	105	169	121	111	136	108	1387

Departures and arrivals	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
UA556	437	368	423	385	413	393	407	256	216	162	217	232	3909
UM548	147	126	130	130	132	119	130	111	94	102	109	115	1445
UA321	119	112	117	101	89	111	123	121	119	119	127	156	1414
UM402	123	99	80	96	88	78	13	1	0	0	6	12	596

APPENDIX A

SURVEY ADDRESSED TO SAM STATES AS PART OF THE ATFM IMPLEMENTATION PLAN

Country /State: _________________ Airport:__________________________

Person responding the survey:____

Date: _________________

1. Regarding the SAM ATFM implementation plan, indicate if FMU/FMP units have been established. If the answer is YES, indicate the responsible unit. If the answer is NO, indicate plans for ATFM implementation based on regional requirements.

____
____
____
____

2. Indicate if you have personnel trained in ATFM implementation and if such personnel is currently performing the corresponding functions in accordance with the implementation plan.

____
____
____
____

3. If NO trained personnel is available, indicate the number of people available for receiving training in the ATFM implementation plan.

____
____
____
____

4. In your State/country, how many airports have runway capacity calculation? List the most important ones. If your answer is NONE, indicate what airports have runway capacity calculation. List the most important ones. If your answer is NONE, indicate what airports you consider require such calculation.

____
____
____
____

5. In your State/country, how many airports have apron capacity calculation? List the most important ones. If your answer is NONE, which airports to you consider require such calculation?

____
____
____
____

6. In your State/country, what airports have ATS sector capacity calculation? List the most important ones. If your answer is NONE, what airports you think require it?

____
____
____
____

7. For the airport that you consider of greatest importance, indicate the following in terms of the number of operations per hour:

- Runway capacity: _____________
- Apron capacity: _____________
- ATS sector capacity: _____________

8. For the airport that you consider of greatest importance, indicate the number of trained people in a position to calculate, in terms of operations per hour:

- Runway capacity: _____________
- Apron capacity: _____________

- ATS sector capacity ____________

9. List the airports in which demand exceeds runway capacity and indicate the operational factors affecting them.

____
____
____
____
____
____

APPENDIX A-1

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	**Sep 2008**	**Apr 2010**		
1.9 Carry out Calculation of Airport and Airspace Capacity of main airports by States. 1. Identify main airports. 2. Identify airports exceeding runway capacity. 3. Carry out capacity and ATS sector calculation capacity. 4. Define airports capacity. 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/8 SAM/IG/12	States	**Valid** Brazil, Paraguay and Peru presented the data. Venezuela presented its runway capacity calculation for the Maiquetía airport. Chile announces completion of estimates in its main airport, results to be provided mid-June. Valid in view of the lack of estimates in some airports. As a conclusion encourage States to accelerate publication of data, date to be determined by Secretariat, even though the tentative date would be SAM/IG/11. States that have not yet done so are encouraged to submit the required information. Item 4 has to be presented to SAM/IG/13.
1.10 Identify airports where periods exist where the demand is greater than existing capacity including simulations, if necessary, by States.	Sep/Oct 2009	SAM/IG/8	States	**Permanent** Brazil, Paraguay and Peru presented the data. It is suggested to merge 1.9 with

A: AIRPORT				
Task description	**Start**	**End**	**Responsible party (designate individual or organisation in charge)**	**Remarks**
				~~1.12 and 1.10 with 1.11 in order to assure States that the aim of these tasks is to share information.~~ 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	~~SAM/IG/8~~	States	**Valid** Brazil, Paraguay and Peru presented the data.
1.12 ~~Present the conclusions on existing airport capacity.~~ Notify airport capacity in terms of aircraft operation in main airports.	~~N/A~~ SAM/IG/12	~~SAM/IG/8~~	States	~~**Valid**~~ ~~Brazil and Peru presented their conclusions on airport capacity (runway capacity)~~ **Permanent** Updated in each SAM/IG.
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 CDM course together with the runway capacity and ATS sectors courses, for June 2013.~~ ~~2. ICAO Office to ask DECEA-CGNA a basic course for States: tentative date June 2013.~~ 1. Consider the implementation of a CDM process in main airports. 2. States will notify airports with this process.	**SAM/IG/11**	~~December 2010~~	States	~~**Finalized**~~ ~~An AFTM/CDM course was carried out in Brazil in 2010 with the participation of several States.~~ **Valid** ATFM operational concept, ATFM manual, ATFM roadmap will be taken into accout.
3. Infrastructure and database		~~**Aug 2008**~~		

A: AIRPORT

Task description	**Start**	**End**	**Responsible party (designate individual or organisation in charge)**	**Remarks**
3.2 ~~Send to the Automation Group the information obtained by the expert hired on the data bases used in the Brazil, United States and EUROCONTROL units.~~ Establish a data base format to be used for automation.	~~Jan 2009~~ SAM/IG/11	~~TBD~~	States	**Valid** ~~The meeting was informed that the Secretariat will follow-up on this matter.~~
~~3.3 Coordinate implementation activities with the Automation Group.~~			~~ATFM/IG~~	~~**Permanent**~~ ~~Hire a group of experts to review the manual.~~
4. Policy, standards, and procedures				
4.7 ~~Keep updated AIP/AIC Supplements.~~ Ask States to submit AIP/AIC published information on ATFM. 1. Standardize this information. 2. Update the information.	SAM/IG/11	~~SAM/IG/10~~	States	**Permanent** Information will be presented in each SAM/IG
5. Training				
5.1 Draft ATFM training plans and submit them.	SAM/IG/11	~~TBD~~	States	**Permanent**
5.6 Train FMP/FMU staff for application of ATFM measures for airports.	SAM/IG/11	~~TBD~~	States	**Permanent**
5.7 Monitor the training of the ATM community.	SAM/IG/11	~~SAM/IG/10~~	States	**Permanent**
6. Final implementation decision				
6.1 Identify and review factors that may affect the implementation decision.		~~SAM/IG/10~~	States	**Valid**

A: AIRPORT				
Task description	**Start**	**End**	**Responsible party (designate individual or organisation in charge)**	**Remarks**
6.2 Declare the pre-operational implementation in the defined area.		SAM/IG/10	States	**Valid** Declare definitive date for implementation.
6.3 Declare the final operational implementation in the defined area.		SAM/IG/10	States	**Valid**
7. Monitor system performance				
7.1 Draft the ATFM post-implementation follow-up programme at airports. Draft performance indicators according to CDM manual.	SAM/IG/6 SAM/IG/11	SAM/IG/10 SAM/IG/12	ATFM/IG States	**Valid**
7.2 Implement the ATFM post-implementation follow-up programme at airports.	SAM/IG/7	SAM/IG/10	States	**Valid**
Tentative pre-operational implementation date SAM/IG 7.3 Develop an indicators follow-up programme	SAM/IG/11	SAM/IG/10	States	**Valid**
Tentative definitive implementation date		SAM/IG/10	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 Prepare an airspace demand survey. 1. Identify personnel available in each State to carry out calculation of air space capacity. 2. Identify which sectors already count with calculation of capacity. 3, Identify, prioritize and report what sectors require calculation of capacity. 4. Identify sectors exceeding capacity.	TBD SAM/IG/11	TBD SAM/IG/11	States	**Valid** **Permanent** States that have not yet done so are encouraged to submit the required information.
1.4 Carry out the States estimate airspace ATC sector capacity at the major airports.	Sep 2009	SAM/IG/10 SAM/IG/13	States	**Valid** States must submit their studies before the SAM/IG/10 Meeting. Brazil has presented their studies.
1.5. Identify airspace sectors where demand sometimes exceeds capacity, including simulations by the States, if necessary.	TBD	SAM/IG/10	States	**Permanent** States must submit their studies before the SAM/IG/10 Meeting. 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	SAM/IG/10	States	**Permanent** States must submit their studies before the SAM/IG/10 Meeting. Brazil has presented their studies.

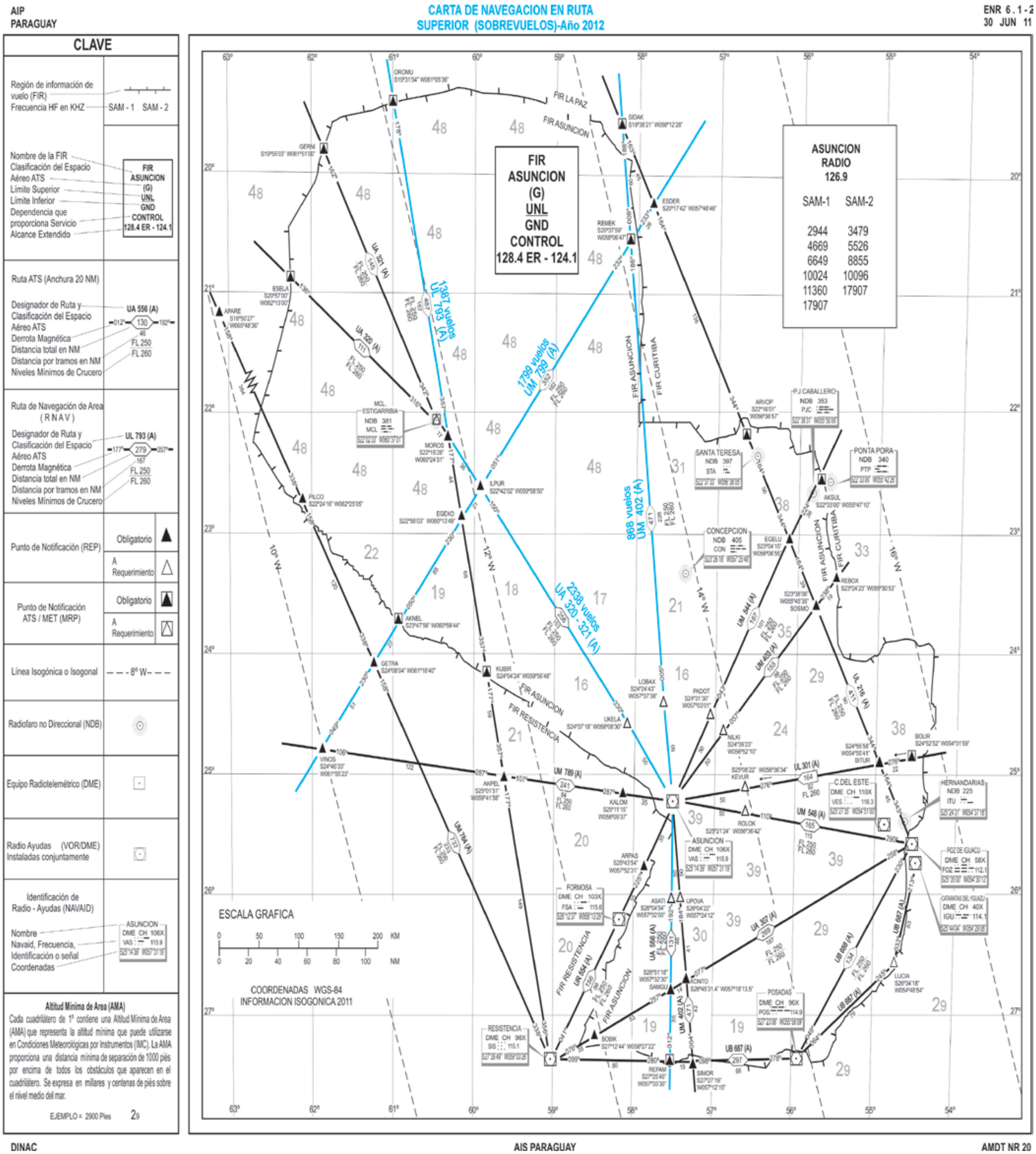
ACTION PLAN FOR ATFM IMPLEMENTATION IN THE SAM REGION				
B- AIRSPACE (ATC Sector)				
Task description	**Start**	**End**	**Responsible party(designate individual or office in charge)**	**Remarks**
1.7 Present conclusions on the existing airspace capacity.	TBD	SAM/IG/10	States	**Valid** States must submit an information paper on the situation before the SAM/IG/10 Meeting. Brazil has presented their studies. **Permanente** Brazil has presented their studies.
2. Coordination with the ATM community	**Sep 2008**	**Aug 2009**		
2.1 Consider by the ATM community the implementation of ATFM in airspace Promote seminars to the ATFM community considering the airspace capacity concept for the implementation of ATFM and initiate corresponding coordinations.	Sep 2008 SAM/IG/11	SAM/IG/10	States	**Valid** States in implementation phase should coordinate with the ATM community the necessary actions for the ATFM implementation process and submit them to the Secretariat before the SAM/IG/10 Meeting. Submit for consideration of the Secretariat the new tasks form proposed by Colombia and discussed by all. Secretariat must issue a communication so that States define who may implement ATFM.
3. Infrastructure and database	**TBD**	**Dec 2013**		
3.1 Send requirements to the Automation Group, as stipulated in Appendix B of the ATFM CONOPS.	TBD	TBD SAM/IG/12	ATFM/IG	**Valid** Brazil has already

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**
The ATFM/IG Group will present the basic requirements for a regional automated system.				implemented.
3.2 Coordinate implementation activities with the Automation Group.	N/A	Dec 2013	ATFM/IG	**Valid** Depends on information of 3.1.
4. Policy, standards, and procedures	**TBD**	**Jun 2013**	States	
4.1 Develop ATFM policies, taking into account the objectives and principles established in the CAR/SAM ATFM CONOPS.	TBD	TBD	States	**Valid**
4.2 Develop a regional strategy and framework for the implementation of Centralized ATFM units.	2008	2014	Regional Project RLA/06/901	**Valid**
4.3 Develop template/contents for operational agreements between Centralized ATFM units for interregional demand/capacity balancing.	2008	2014	Regional Project RLA/06/901	**Valid**
4.4 Define common elements of situational awareness between FMUs; • common traffic displays; • common weather displays (Internet); • communications (teleconferences, web): and • daily teleconference/messages methodology advisories.	2008	2012	Regional Project RLA/06/901 States	**Permanent** Subject to evaluation of SAM/IG/10 WP/12 States maintain web conferences for exchange of information.
4.5 Define common electronic information and minimum databases required to support decision making process and alerting systems for interoperable situational awareness between Centralized ATFM units. Review the regional ATFM implementation roadmap to be used by States as FMU/FMP implementation guide.	2008 SAM(IG/11	2014 SAM/IG/12	Regional Project RLA/06/901	**Valid**

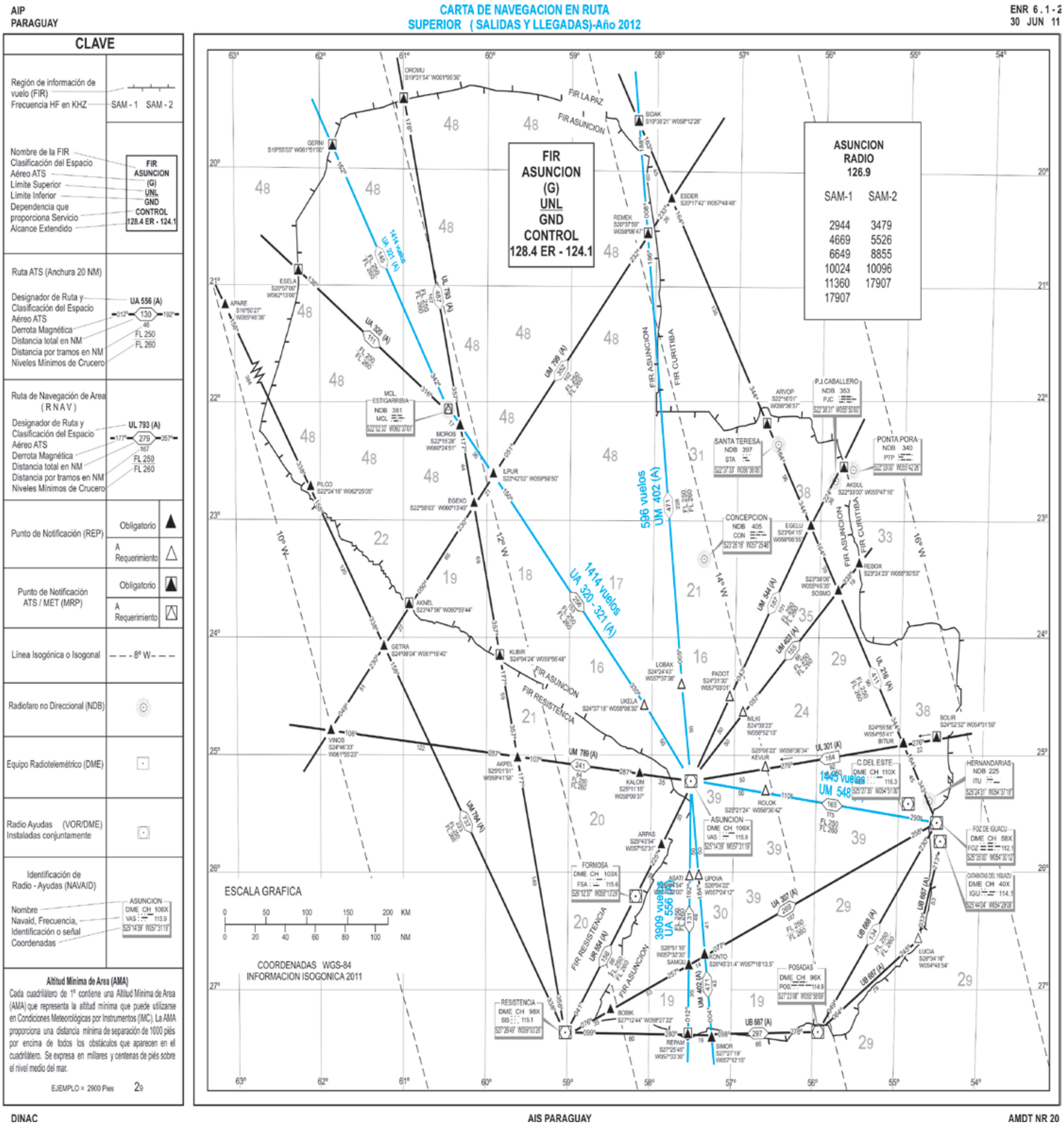
ACTION PLAN FOR ATFM IMPLEMENTATION IN THE SAM REGION				
B- AIRSPACE (ATC Sector)				
Task description	**Start**	**End**	**Responsible party(designate individual or office in charge)**	**Remarks**
4.6 Develop a regional strategy to implement the use of a flexible upper airspace (FUA): • evaluate the 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; • 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.	2008	2015	Regional Project RLA/06/901	**Valid**
5. Training	**TBD**	**TBD**		
5.3 ~~Train personnel in ATFM strategic measures for airspace.~~ Train personnel in the sector capacity calculation and subjects related to ATFM for the airspace.	TBD	TBD	States	**Permanent** ~~An ATFM CDM course was carried out in Brazil in 2010 with the participation of several States~~
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	~~**N/A**~~	~~**Sep 2012**~~	~~States~~	

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**
6.1 Analyse factors affecting the implementation decision.	N/A	SAM/IG/11	States	**Valid** Initial end date: SAM/IG/8
6.2 Declare pre-operational implementation in the area defined.	N/A	SAM/IG/12	States	**Valid** Initial end date: SAM/IG/8
6.3 Declare definitive operational implementation in the area defined.	N/A	SAM/IG/12	States	**Valid** Initial end date: SAM/IG/8
7. Monitor system performance	**TBD**	**N/A**	States	
7.1 Prepare ATFM system performance supervision plan Draft performance indicators	2010	2013	Regional Project RLA/06/901	**Valid**
7.2 Draft ATFM post-implementation follow-up programme. Develop an indicators follow-up programme.	TBD	Aug 2013	States	**Valid**
7.3 Implement ATFM post-implementation follow-up programme.	Dec 2013	N/A	States	**Valid**
Tentative pre-operational implementation date	**N/A**	**Jul 2013**	States	**Valid**
Tentative definitive implementation date	**N/A**	**Dec 2013**	States	**Valid**

APPENDIX B


AIP
PARAGUAY
CARTA DE NAVEGACION EN RUTA
SUPERIOR (SOBREVUELOS)-Año 2012
ENR 6.1-2
30 JUN 11
CLAVE
Región de información de vuelo (FIR)
Frecuencia HF en KHZ
SAM-1 SAM-2
Nombre de la FIR
Clasificación del Espacio Aéreo ATS
Límite Superior
Límite Inferior
Dependencia que proporciona Servicio
Alcance Extendido
Ruta ATS (Anchura 20 NM)
Ruta de Navegación de Area (RNAV)
Punto de Notificación (REP)
Obligatorio
A Requerimiento
Punto de Notificación ATS / MET (MRP)
Línea Isogónica o Isogonal
Radiofaro no Direccional (NDB)
Equipo Radiotelemétrico (DME)
Radio Ayudas (VOR/DME) Instaladas conjuntamente
Identificación de Radio - Ayudas (NAVAID)
Altitud Mínima de Area (AMA)
FIR ASUNCION (G) UNL GND CONTROL 128.4 ER - 124.1
ASUNCION RADIO 126.9
SAM-1 SAM-2
2944 3479
4669 5526
6649 8855
10024 10096
11360 17907
17907
1387 vuelos UL 793 (A)
1799 vuelos UM 799 (A)
868 vuelos UM 402 (A)
2339 vuelos UA 320 - 321 (A)
FIR LA PAZ
FIR ASUNCION
FIR CURITIBA
FIR RESISTENCIA
ESCALA GRAFICA
COORDENADAS WGS-84
INFORMACION ISOGONICA 2011
DINAC
AIS PARAGUAY
AMDT NR 20

APPENDIX C


AIP
PARAGUAY
CARTA DE NAVEGACION EN RUTA
SUPERIOR (SALIDAS Y LLEGADAS)-Año 2012
ENR 6.1-2
30 JUN 11
CLAVE
FIR
ASUNCION
(G)
UNL
GND
CONTROL
128.4 ER - 124.1
ASUNCION
RADIO
126.9
1414 vuelos
UA 320 - 321 (A)
596 vuelos
UM 402 (A)
3909 vuelos
UA 556
1445 vuelos
UM 548
ESCALA GRAFICA
COORDENADAS WGS-84
INFORMACION ISOGONICA 2011
DINAC
AIS PARAGUAY
AMDT NR 20

Agenda Item 5: Assessment of operational requirements in order to determine the implementation of communications 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/07 - *Follow up to the implementation of the new South American Digital Network -- REDDIG II* (Secretariat);
- WP/08 -*Activities carried out under project ATN Architecture in the SAM Region* (D1 Project Coordinator);
- WP/09 - *Follow-up to the activities of Project D2 - ATN Ground-ground and Air-ground Applications in the SAM Region* (D2 Project Coordinator);
- WP/24 - *Second edition of the Global Operational Data Link Document (GOLD)* (Secretariat);
- WP/17 - *Follow-up on activities of Project air navigation systems in support of PBN* (Secretariat);
- WP/19 - *Follow-up on tests for the interconnection of AMHS* (Peru);
- WP/20 - *Results of the Regional Preparatory Workshop for International Telecommunications Union World Radio communication Conference (ITU WRC-15)* (Secretariat); y
- IP/06 – *Expanding Future Air Navigation System (FANS) utilization* (BOEING).

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

- Activities carried out under project ATN Architecture in the SAM Region - Project D1;
- Follow-up to the activities of Project ATN Ground-ground and Air-ground Applications in the SAM Region – Project D2;
- Ground-air data links;
- Follow-up on activities of Project Air Navigation Systems in Support of PBN – Project A2; and
- Preparation for the International Telecommunications Union World Radio communication Conference (ITU WRC-15).

Activities carried out under project ATN Architecture in the SAM Region - Project D1

5.3 The Meeting, upon analysing the activities carried out by Project D1, took note of the progress made in the implementation of REDDIG II, as well as in the drafting of the *Guideline for the safety in the implementation of IP networks,* and of the *Guide for the routing policy for the SAM Region*.

Progress in the implementation of REDDIG II

5.4 The Meeting was informed that the contract between ICAO and the REDDIG II bid winner (INEO Consortium - Level 3) had been completed, examined and signed by both parties on 9 May 2013. It should be highlighted that during the re-negotiation period, added material and services were obtained, without an increase in the budget, which is a clear advantage for the States. During the mentioned period, the bid winner's Service Level Agreement (SLA) regarding the ground communications services provision, was examined upon. In this respect, it was considered that the SLA's period of validity would be during the first six months of the service's operation and, in the event the REDDIG member decide to extend the ground service provision contracts, a new revision would be made to the SLA.

5.5 In this sense, the Meeting noted that the REDDIG II contract process had started. The contract will be carried out in two phases, Phase 1, already started, where the bid winner will prepare the REDDIG II design documents, the installation procedures, the training manuals, the factory acceptance documents, the on-site documents, the network documents, the network management system (NMS); while Phase 2 includes REDDIG II installation and would be starting in November 2013, as long as all REDDIG member States have cancelled their REDDIG II quotas. Practically all REDDIG member States have deposited their corresponding contributions, pending only two States.

5.6 INEO Consortium Level 3 will hand ICAO the documents foreseen in Phase 1 by mid-August 2013. ICAO, once having received the documents, will send them to all REDDIG II focal points (refer to **Appendix A** to this Agenda Item), for their initial review. The final documentation review will be carried out during the *Meeting on the Technical-Operational Implementation of REDDIG II*, to be held in Lima, Peru, from 9 to 13 September 2013. **Appendix B** to this Agenda Item presents the tentative REDDIG II implementation schedule.

5.7 With regard to the effective implementation of the new infrastructure, it is important to highlight that the role of the focal points nominated by States will be decisive for the success of all actions to be undertaken. Their main function will be to participate in the installation of the corresponding REDDIG II node, the provisional and final node acceptances, the obtainment of the frequency licenses and the equipment customs clearance.

REDDIG Website

5.8 The Meeting was informed that a new website has been designed in order that REDDIG member States can find in one single page all information pertaining to Project RLA/03/901 - *REDDIG Management and Satellite Segment Administration System*. The site's url is: http://www1.lima.icao.int/reddig/.

REDDIG project presentation at AN-Conf/12

5.9 The Meeting took note that the working paper prepared by Brazil, with the support of all REDDIG member States, on the experience gained in the implementation process of a mixed (satellite/ground) IP digital network, obtained with the support of an ICAO technical cooperation Project, had great acceptance at the Conference, with the formulation of Recommendation 1/6 – *Data communications issues*.

Interference of the international mobile telecommunications (IMT) system in the fixed satellite service (FSS) band

5.10 The Meeting analysed the interference produced in the Lima, Peru REDDIG node in September 2012 by an IMT system, the WIMAX (broadband internet wireless transmission service transmitting in the 2.3 to 3.5 Ghz band). The interference kept the Lima node out of service for five days, the services during that period were offered through the ISDN backup ground network. The interference was solved with the installation of a filter in the REDDIG node.

5.11 In this respect, the Meeting deemed it convenient that States take note of this interference case and that they inform their local radio frequency spectrum administration of this, to avoid possible interferences at other REDDIG nodes.

Guide for the safe implementation of IP networks and Guideline for a routing policy in the SAM Region

5.12 The Meeting analysed the *Guide for the safe implementation of IP networks* and the *Guide for a routing policy in the SAM Region*, drafted by two Brazilian experts, and presented as **Appendices C and D** to this Agenda Item. The Guides were elaborated thanks to the support for the administration of Brazil and RLA/06/901 Project. In this regard, the Meeting considered that same should be circulated to States for their review.

Situation of the project

5.13 The Meeting considered that, with the drafting of the afore mentioned Guides, the only activity pending was the follow-up to REDDIG II implementation. The D1 Project Coordinator (Mr. Athayde Frauche), informed he would be leaving this posit as he was retiring from the Brazilian administration, and thanked all Project D1 collaborators. The Meeting thanked him for the excellent task undertaken by the Coordinator, hoping to count with his know-how for the Project. **Appendix E** to this Agenda Item presents the Project description, as well as the activities conducted.

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

5.14 With regard to the activities involved in this Project, the Meeting noted that same could be summarized in the following topics:

a) Follow-up to the operational interconnection of AMHS;
b) Operational integration of international AIDC connections in the SAM Region; and
c) Drafting of guidelines for:
   - AIDC implementation, and
   - Ground-air data link applications implementation.

5.15 **Appendix F** presents the description of Project D2 to date, whose activities were related with ASBU Block 0 modules.

Situation of the project

5.16 The Project D2 Coordinator (Mr. Omar Gouarnalusse) informed that, due to the new post he had assumed within his Administration and to the workload it infers, he could no longer continue with the Project, and thanked the support received from all Project collaborators. The Meeting thanked him for the excellent work conducted, hoping to count in the near future with this valuable support. As the new Project D2 Coordinator, Mr. Gustavo Chiri was considered for appointment.

Follow-up to the operational interconnection of AMHS

5.17 The Meeting took note of the progress made in the interconnection of AMHS, summarizing hereunder the situation to date (**Appendix G** presents the complete and updated action plan):

5.17.1 *Operational interconnections* (in chronological order):

a) Colombia – Peru (systems from same provider)
b) Guyana – Suriname (systems from same provider)
c) Argentina – Paraguay (systems from same provider)
d) Peru – Ecuador (systems from different provider)

5.17.2 *Pending interconnections (with signed MoUs):*

a) Argentina – Peru
b) Argentina – Brazil
c) Argentina – Chile
d) Brazil – Colombia
e) Brazil - Paraguay
f) Brazil – Peru
g) Brazil – Venezuela
h) Peru - Venezuela

5.17.3 *Inter-regional trials:* Brazil and Spain conducted satisfactory tests, reaching up to message exchanges, step previous to operational exchanges.

5.18 With regard to the difficulties found in the international operational interconnection is between systems from different providers, there was unanimous agreement with regard to the proposal presented by Peru (WP/19), agreeing to formulate the following Conclusion:

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.

5.19 In addition, the Meeting took into account the importance of holding the *Course on ATS message handling system (AMHS)* to be conducted in Lima, Peru, from 24 to 28 June 2013, which will contribute to facilitating international interconnections.

International AIDC connections operational integration in the SAM Region

5.20 With respect to this activity, same is being monitored by the Automation Group, and the information is found under Agenda Item 6.

Drafting of a guideline for AIDC implementation and of orientation for the implementation of ground-air data link applications

Guideline for AIDC implementation

5.21 The Meeting noted that in accordance with Project D2 activities and thanks to the support of RLA/06/901 Project and the administration of Argentina, two experts from the CNS and ATM area elaborated last April a *Guideline for AIDC interconnection*. In this sense, the Meeting analysed the preliminary Guide presented. It was concluded that the technical part was complete, but the operational section on the minimum set of possible AIDC messages, needed revising. In this respect, the Meeting deemed it convenient that the Guide be circulated to the States of the Region for their review. The preliminary Guide is included as **Appendix H** to this Agenda Item**.**

Orientation guideline for the implementation of ground-air data link application

5.22 The Meeting took note that the sixth meeting of the Coordination Committee (RCC/6) of RLA/06/901 Project had approved the mission of a CNS expert for the drafting of this Guide. Same will be elaborated in October of this year, ant presented at SAM/IG/12 meeting.

Ground-air data links

5.23 The Meeting took note of the *Global Operational Data Link Document (GOLD), Version 2,* and considered convenient that it be adopted in the Region as a reference oepreational document of remote oceanic and continental area data links. Copy of the GOLD Manual is shown in the Appendix to WP/24. .

5.24 In addition, the Meeting deemed convenient that States with oceanic FIRs and using ground-air data links [CPDLC, ADS-C (FANS 1 A)] monitor their use, having for this with the information contained in Appendix D to the GOLD Manual, with the aim of standardizing the data collection procedure as well as its later processing, situation that will enable guaranteeing safety assessment and complying with ICAO Annex 11, paragraph 2.2.7.5.

5.25 The Boeing representative delivered a presentation on the benefits of FANS, inviting the air navigation services providers and operators to use this technology and offering support to interested States in the conduct of trials in this regard.

Follow-up on activities of Project Air Navigation Systems in Support of PBN – Project A2

5.26 The Meeting analysed to the progress made regarding the tasks included in Project A2, and considered that same had been completed, becoming necessary to monitor the following: :

a) Translation into Spanish of the *Practical guide for the implementation of GBAS systems*;
b) Updating of DME/DME coverage in support of PBN procedures, in the event of changes in the current regional situation regarding DME. In this respect, as per Conclusion SAM/IG/7-6, States should inform the ICAO SAM Regional office of corresponding changes; and
c) Implementation of a RAIM availability prediction service, whose technical specifications are in the ICAO Technical Cooperation Bureau since the end of April 2013 for its review and starting of the bidding process.

5.27 The Meeting analysed the recommendations formulated at the Twelfth Air Navigation Conference (AN-Conf/12) with regard to Global Navigation Satellite System (GNSS) topics, and deemed convenient to follow-up on same.

Preparation for the International Telecommunications Union World Radio communication Conference (ITU WRC-15)

5.28 The Meeting took note of the information regarding the ICAO position at IUT WRC 15, presented at the *Regional Preparatory Workshop for International Telecommunications Union World Radio communication Conference (ITU WRC-15)* held in Lima, Peru, from 11 to 12 March 2013.

5.29 In this respect, the Meeting deemed important that States of the Region take into account the implementation of the following actions:

a) Ensure the protection of the VSAT aeronautical networks operating in the band between 3.4 to 4.2 Ghz with regard to the international mobile telecommunications (IMT) services, and inform of any interferences to the national entities managing the radio frequency spectrum, as well as to the ICAO SAM Regional Office;
b) Examine COM 1, COM 2 and COM 3 lists available at the ICAO SAM Regional Office website, to confirm the use of the frequencies assigned and notify on any updating required; and

c) If not yet implemented, formalize a mechanism or procedure with the national authorities on spectrum management for the detection and solution of unauthorized transmissions causing interferences to the aeronautical services.

5.30 In this sense, the Meeting deemed necessary to formulate the following Conclusion:

Conclusion SAM/IG/11-5 Use of the radio frequency spectrum

That, the States of the SAM Region:

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;
b) Examine lists COM 1 to 3 and confirm the use of the frequencies assigned, notifying of any changes therein; and
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.

APPENDIX A / APENDICE A
REDDIG II FOCAL POINTS / PUNTOS FOCALES REDDIG II

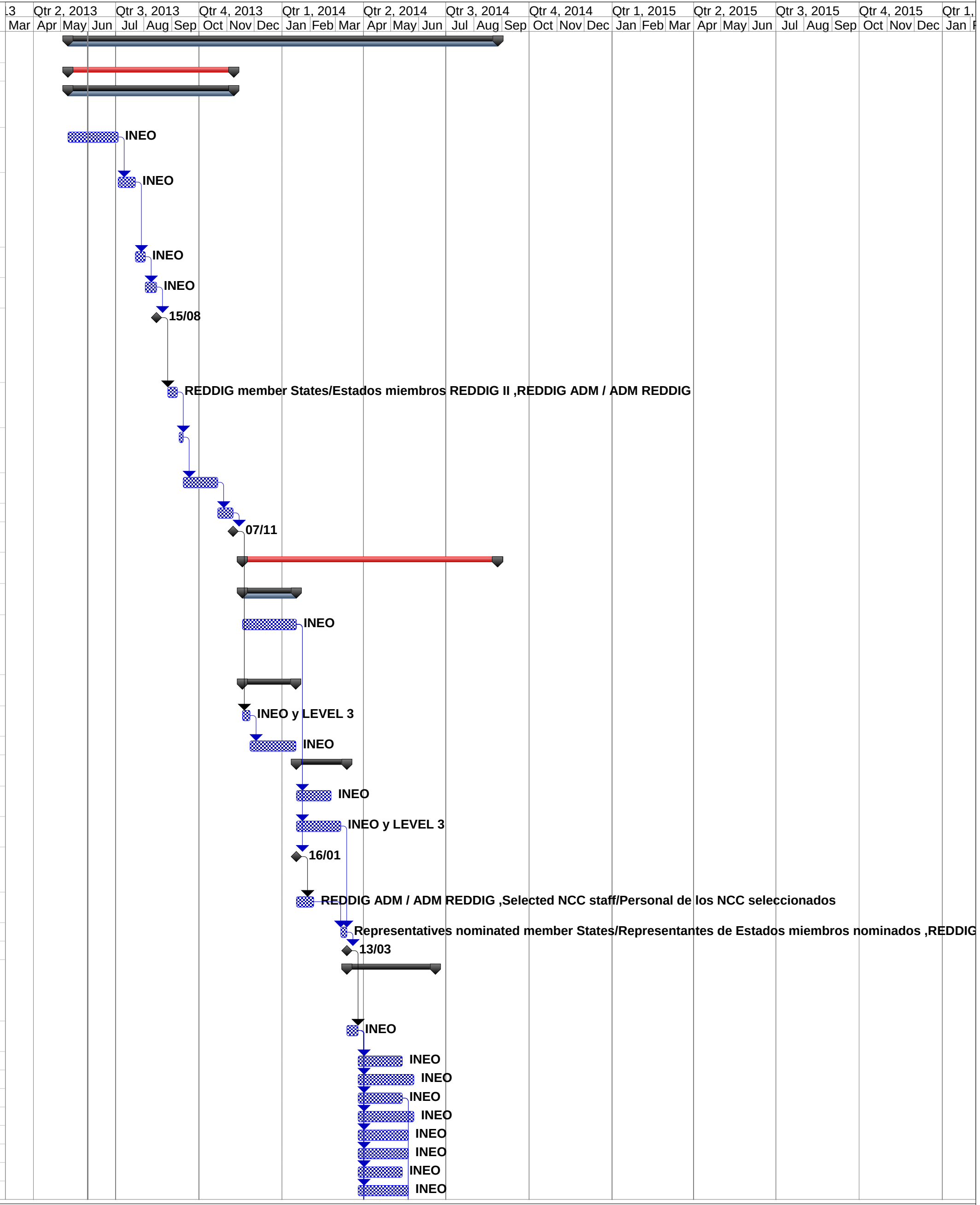
STATE / ESTADO	NAME / NOMBRE	POST / CARGO	E-MAIL / CORREO-E	TELEPHONE/ TELEFONO	ADDRESS / DIRECCION
ARG	Moira Lidia Callegare, ANAC	Jefe Departamento Proyectos – DNSA	mcallegare@anac.gov.ar	(5411) 594-13097	Edificio ANAC Central Paseo Colón 1452, Ciudad Autónoma de Buenos Aires, CP 1063
	Sergio Alberto Vallone, ANAC	Inspector de Navegación Aérea, Depto. Regional Noroeste de Inspecciones de la Dirección Nacional de Inspecciones de Navegación Aérea	svallone@anac.gov.ar	(54351) 475-6414	Dirección Regional Noroeste Camino Pajas Blancas Km. 8.5, CP 5000, Córdoba Capital
	Obdulio Gouarnalusse, DGCTA - FFAA	Jefe Departamento de Proyectos	ogouarna@faa.mil.ar; ogouarnalusse@gmail.com	(5411) 4480-2362; (5411) 5166-2362	Av. Comodoro Pedro Zanni 250, Edif. Cóndor, Sector Amarillo, Of. 472, 1104 Buenos Aires
	Cristian Javier Vittor, DGCTA - FFAA	Asesor de la Dirección C.N.S.	jvittor@anac.gov.ar; javiervittor@gmail.com	(5411) 4480-2362; (5411) 5166-2362; (5411) 44802350	Av. Comodoro Pedro Zanni 250, Edif. Cóndor, Sector Amarillo, Of. 472, 1104 Buenos Aires
BRA	Athayde Licério Frauche, DECEA	Oficial CNS Coordinador REDDIG	dcte4@decea.gov.br, frauche@hotmail.com	(5521) 2101-6584; (5521) 2101-6219	Av. General Justo 160, Rio de Janeiro, Brasil
BOL	Hernando Lara, AASANA	Jefe Unidad Nacional CNS AASANA	nanos_24@hotmail.com	(5912) 212-7959	Aeropuerto Internacional El Alto, Bloque Técnico AASANA
	Remigio Blanco, AASANA	Responsable de Telecomunicaciones AASANA	rblanco@aasana.bo	(5912) 237-0340	Aeropuerto Internacional El Alto, Bloque Técnico AASANA
CHI	Christian Vergara Leyton, DGAC	Supervisor de Mantenimiento Técnico Centro de Control de Santiago	cvergara@dgac.cl	(562) 836-4005; (562) 836-4011; (562) 644-8345	Avenida San Pablo 8411, Comuna de Pudahuel, Santiago, Chile
	Pedro Pastrián Céspedes, DGAC	Supervisor de Mantenimiento Técnico Centro de Control de Santiago	ppastrian@dgac.cl	(562) 836-4005; (562) 836-4011; (562) 644-8345	Avenida San Pablo 8411, Comuna de Pudahuel, Santiago, Chile
COL	Henry Mendoza Sandoval, UAEAC	Director de Telecomunicaciones y Ayuda a la Navegación Aérea	henry.mendoza@aerocivil.gov.co	(571) 296-2224; (57) 317-5170996	Aeropuerto Internacional El Dorado, Av. El Dorado N° 112-09 Edif. C.N.A. (Centro Nacional de Aeronavegación)
	Gabriel Enrique Guzmán Pachon	Jefe del Grukpo de Sistemas de Comunicaciones	gabriel.guzman@aerocivil.gov.co	(571) 296-2940; (57) 317-656 7202	Aeropuerto Internacional El Dorado, Av. El Dorado N° 112-09 Edif. C.N.A. (Centro Nacional de Aeronavegación)
ECU	Rául Avellán Oña, DGAC	Dirección de Nodo Aeropuerto "José Joaquín de Olmedo"	ravellan1@yahoo.com raul.avellan@dgac.gob.ec	(593-4) 269-2829	Av. De las Américas, Edif. Servicio para la Navegación Aérea, Guayaquil
FRA	Michel Metzelard, SNA-AG/Centre de Contrôle de Cayenne Félix Eboué	Chef de maintenance	michel.metzelard@aviation-civile.gouv.fr	(594) 594-359317 (Tech room); (594) 594-359321 (Antenna station)	Aviation Civile, Aeroport de Cayenne Félix Eboué, 97351 Matoury, Guyane Francaise

STATE / ESTADO	NAME / NOMBRE	POST / CARGO	E-MAIL / CORREO-E	TELEPHONE/ TELEFONO	ADDRESS / DIRECCION
GUY	Mortimer Salisbury, Guyana Civil Aviation Authority	Supervisor - AN & T	mbsalisbury2000@yahoo.com	(592) 261-2569	Control Tower complex, Cheddi Jagan International Airport, Timehri, East Bank Demerara, Guyana
	Sewchan Hemchan, Guyana Civil Aviation Authority	Electrical Engineer	sewchan_hemchan@yahoo.com	(592) 261-2569	Control Tower complex, Cheddi Jagan International Airport, Timehri, East Bank Demerara, Guyana
PAR	Ramón Salinas Ruiz, DINAC	Gerente de Telecomunicaciones y Electrónica	salinas_184@hotmail.com; salinas_184@gmail.com	(595) 21 758 5208	Centro de Control Unificado, Gral. Artigas y Fernando de Mompox, Mariano Roque Alonso, Paraguay
	Aldo Pereira Alcaraz, DINAC	Jefe Sección Radiocomunicaciones	aldopereira26@gmail.com	(595-21) 645-708; (595-21) 645598	Centro de Control Unificado, Gral. Artigas y Fernando de Mompox, Mariano Roque Alonso, Paraguay
PER	Luis Silva Gárate, CORPAC	Jefe del Equipo encargado de la Operac. y Mantto. del Nodo REDDIG-Lima	lsilva@corpac.gob.pe	(511) 515-3015; (511) 414-1250	Aeropuerto Internacional Jorge Chávez, Callao, Perú
SUR	Rabindre Maharban, Ministry of Transport, Communication and Tourism, Civil Aviation Department	Chief CNS Technical Division	cad.navcom@tct.gov.sr; rabindre2000@yahoo.com	(597) 325-123; (597) 325-172; (597) 497-143	J. A. Pengel International Airport, Zanderij, district Para, Zorg en Hoop Airport, Paramaribo
	Renaldo Lansdorf, Ministry of Transport, Communication and Tourism, Civil Aviation Department	Senior Aeronautical Telecommunication Technician	r.lansdorf@yahoo.com	(597) 325-123; (597) 325-172	J. A. Pengel International Airport, Zanderij, district Para, Zorg en Hoop Airport, Paramaribo
TRI	Rohan Garib, Civil Aviation Authority	Executive Manager Air Navigation Services	rgarib@caa.gov.tt	(1-868) 669-4806 (1-868) 669-4706,	Trinidad and Tobago Civil Aviation Authority Complex, Caroni North Bank Road, Piarco
	Veronica Ramdath, Civil Aviation Authority	Manager Telecommunications and Electronics	vramdath@caa.gov.tt; vramdath@gmail.com		
URU	Marcos Vignolo, DINACIA	Director de Electrónica	mvignolo@dinacia.gub.uy	(5982) 6010932, Ext. 4520	Aeropuerto Internacional de Carrasco Av. Wilson Ferreira Aldunate 253 Paso Carrasco, Canelones
	Miguel Vera, DINACIA	Técnico de la División Comunicaciones	miguelvera@adinet.com.uy	(5982) 6010932, Ext. 4520	Aeropuerto Internacional de Carrasco Av. Wilson Ferreira Aldunate 253 Paso Carrasco, Canelones
VEN	Vicente FioreFedullo, INAC	Jefe Región Maiquetía-Venezuela	v.fiore@inac.gob.ve	(58212) 355-2143; (58212) 355-1412	Edificio ATC, 2do piso, Depto. De Comunica., Maiquetía, Edo. Vargas, Venezuela
	Luis Escobar, INAC	Coordinador de los Sistemas de Comunicaciones CNS Región Maiquetía	l.escobar@inac.gob.ve	(58212) 355-2143; (58212) 355-1412	Edificio ATC, 2do piso, Depto. De Comunica., Maiquetía, Edo. Vargas, Venezuela

APPENDIX B / APENDICE B

TENTATIVE TIME SCHEDULE-PHASES / PROGRAMA TENTATIVO- FASES

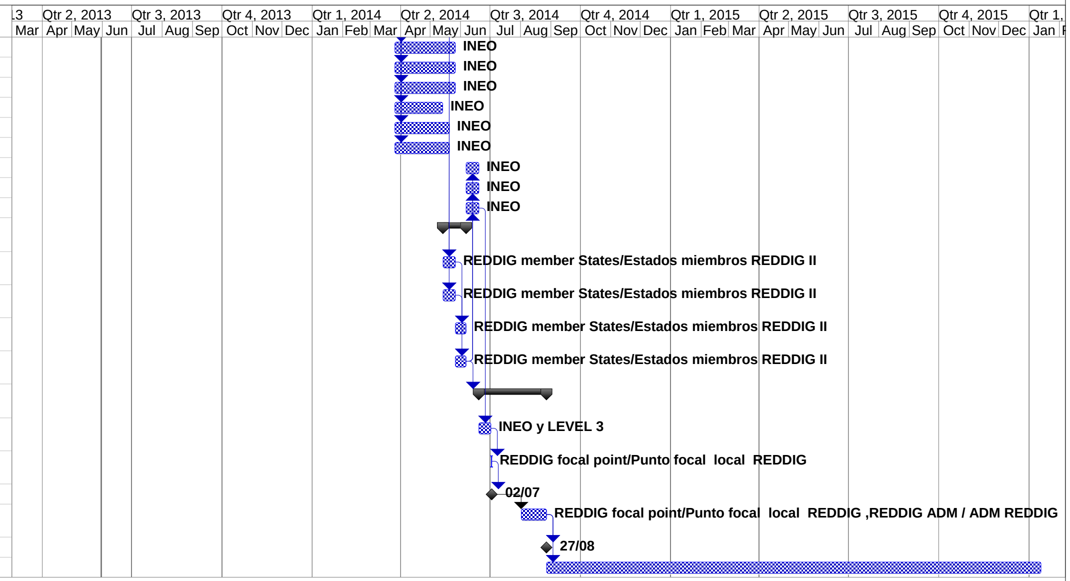
ID	Nom de la tâche	Duration	Start	Finish	Predecessors
1	**Tentative REDDIG II implementation work programme / Programa tentativo de trabajo implantacion REDDIG II**	**388 days**	**Thu 09/05/13**	**Wed 27/08/14**	
2	**Phase 1 - Project / Fase 1 - Proyecto**	**150 days**	**Thu 09/05/13**	**Fri 08/11/13**	
3	**Documentation drafting and approval process / Proceso de elaboración y aprobación documentación**	**150 days**	**Thu 09/05/13**	**Fri 08/11/13**	
4	REDDIG II preliminary design installation / Preparación diseño preliminar instalación REDDIG II (SDD)	45 days	Thu 09/05/13	Wed 03/07/13	
5	Preparation of installation and training procedures documentation and NMS documentaion preparation / Preparacion documentos de procedimiento de instalacion y capacitacion y ptrparacion documentacion del sistema NMS	15 days	Wed 03/07/13	Mon 22/07/13	4
6	FAT protocol preparation / Preparacion protocolo FAT	10 days	Mon 22/07/13	Fri 02/08/13	5
7	SAT protocol preparation / Preparacion protocolo SAT	10 days	Fri 02/08/13	Thu 15/08/13	6
8	Documentation submittance (SDD, FAT/SAT protocol, on-site installation procedure, training manuals) to ICAO / Envio documentación (SDD, protocolo FAT/SAT, procedimiento instalacion sitio, manuales de capacitación) a OACI	0 days	Thu 15/08/13	Thu 15/08/13	7
9	Initial documentation review by REDDIG II Member States / Revision inicial de la documentacion por parte de los miembros de REDDIG ii	10 days	Tue 27/08/13	Fri 06/09/13	8
10	Technical-operational meeting for REDDIG II implementaion / Reunión tecnico-operacional para la implantación de la REDDIG II	5 days	Mon 09/09/13	Fri 13/09/13	9
11	Final review of REDDIG II documentation/Revision final d ela documentación de la REDDIG II	30 days	Fri 13/09/13	Mon 21/10/13	10
12	Final design/Diseño finalizado	15 days	Mon 21/10/13	Thu 07/11/13	11
13	Documentation reviewed and approved / Documentos revisados y aprobados	0 days	Thu 07/11/13	Thu 07/11/13	12
14	**Phase 2 - REDDIG II implementation / Fase 2 - Implantación de la REDDIG II**	**231 days**	**Mon 18/11/13**	**Wed 27/08/14**	
15	**Purchasing and integration of VSAT equipment / Adquisición e itnegración equipos VSAT**	**50 days**	**Mon 18/11/13**	**Thu 16/01/14**	
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	50 days	Mon 18/11/13	Thu 16/01/14	
17	**Preparation of ground backbone network / Preparación red medular terrestre**	**49 days**	**Mon 18/11/13**	**Wed 15/01/14**	
18	Hiring of service for all nodes / Contratación de servicio para todos los nodos	7 days	Mon 18/11/13	Tue 26/11/13	13
19	Equipment purchasing / Adquisión equipos	42 days	Tue 26/11/13	Wed 15/01/14	18
20	**Integration at factory, training and FAT / Integracion en fábrica, entrenamiento y FAT**	**45 days**	**Thu 16/01/14**	**Thu 13/03/14**	
21	Equipment assembling at factory / Ensamblar equipos en fábrica	6 wks	Thu 16/01/14	Mon 24/02/14	16
22	Network configuration and pre-test / Configuracion y pre-test de la red	8 wks	Thu 16/01/14	Thu 06/03/14	16
23	Documentation submittance for on-factory-training / Envío documentación para entrenamiento en fábrica	0 wks	Thu 16/01/14	Thu 16/01/14	16
24	On-factory-training / Entrenamiento en fábrica	3 wks	Thu 16/01/14	Tue 04/02/14	23
25	FAT	5 days	Thu 06/03/14	Thu 13/03/14	24,22
26	FAT signature / Firma FAT	0 days	Thu 13/03/14	Thu 13/03/14	25
27	**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**	**Thu 13/03/14**	**Thu 19/06/14**	
28	Preparation of equipment remittance / Preparación para envio de equipos	2 wks	Thu 13/03/14	Tue 25/03/14	26
29	Ezeiza	8 wks	Wed 26/03/14	Tue 13/05/14	28
30	La Paz	10 wks	Wed 26/03/14	Mon 26/05/14	28
31	Rio de Janeiro	8 wks	Wed 26/03/14	Tue 13/05/14	28
32	Santiago	10 wks	Wed 26/03/14	Mon 26/05/14	28
33	Bogota	9 wks	Wed 26/03/14	Tue 20/05/14	28
34	Guayaquil	9 wks	Wed 26/03/14	Tue 20/05/14	28
35	Georgetown	8 wks	Wed 26/03/14	Tue 13/05/14	28
36	Cayenne	9 wks	Wed 26/03/14	Tue 20/05/14	28



APPENDIX B / APENDICE B

TENTATIVE TIME SCHEDULE-PHASES / PROGRAMA TENTATIVO- FASES

ID	Nom de la tâche	Duration	Start	Finish	Predecessors
37	Asuncion	10 wks	Wed 26/03/14	Mon 26/05/14	28
38	Lima	10 wks	Wed 26/03/14	Mon 26/05/14	28
39	Paramaribo	10 wks	Wed 26/03/14	Mon 26/05/14	28
40	Piarco	8 wks	Wed 26/03/14	Tue 13/05/14	28
41	Montevideo	9 wks	Wed 26/03/14	Tue 20/05/14	28
42	Maiquetia	9 wks	Wed 26/03/14	Tue 20/05/14	28
43	Manaus	2 wks	Fri 06/06/14	Thu 19/06/14	50
44	Recife	2 wks	Fri 06/06/14	Thu 19/06/14	50
45	Curitiba	2 wks	Fri 06/06/14	Thu 19/06/14	50
46	**Theoretical-practical course in Rio de Janeiro / Curso teórico-práctico en Río de Janeiro**	**20 days**	**Wed 14/05/14**	**Fri 06/06/14**	
47	Session 1 (10 Spanish-speaking) / Sesión 1 (10 personas en español)	2 wks	Wed 14/05/14	Mon 26/05/14	31
48	Session 2 (10 Spanish-speaking) / Sesión 2 (10 persons en español)	2 wks	Wed 14/05/14	Mon 26/05/14	31
49	Session 3 (10 Spanish-speaking) / Sesión 3 (10 personas en español)	2 wks	Mon 26/05/14	Fri 06/06/14	47
50	Session 4 (10 English-speaking) / Sesión 4 (10 personas en inglés)	2 wks	Mon 26/05/14	Fri 06/06/14	48
51	**On-site installation activities / Actividades de instalación en el sitio**	**56 days**	**Thu 19/06/14**	**Wed 27/08/14**	**50**
52	Simultaneous on-site installation / Instalación todos los sitios en forma simultánea	2 wks	Thu 19/06/14	Tue 01/07/14	45
53	PSAT / NSAT (provisional and network acceptance test) / (Prueba de aceptacion provisional y de red)	1 day	Wed 02/07/14	Wed 02/07/14	52
54	PSAT / NSAT Signature / Firma	0 days	Wed 02/07/14	Wed 02/07/14	53
55	FSAT (Final acceptance test) / (Prueba de aceptacion final)	4 wks	Fri 01/08/14	Wed 27/08/14	54FS+5 wks
56	FSAT signature / Firma FSAT	0 days	Wed 27/08/14	Wed 27/08/14	55
57	Two (2) years' guarantee / Dos (2) años de garantía	82.26 wks	Wed 27/08/14	Wed 13/01/16	55



APPENDIX C / APENDICE C

GUIDELINE FOR THE SAFE IMPLEMENTATION OF IP NETWORKS
(available in Spanish only for the moment)
GUÍA DE ORIENTACIÓN DE SEGURIDAD PARA LA IMPLANTACIÓN DE REDES IP

RESUMEN

Este documento provee una guía para que los Estados de la Región SAM puedan implementar las mejores prácticas de seguridad en las redes de comunicación de datos componentes de la ATN SAM.

BORRADOR

Abril 2013

ÍNDICE

1 INTRODUCCIÓN

Este documento es una guía para que los Estados y Organizaciones de la Región SAM puedan implantar las redes de datos componentes de la ATN SAM con las mejores prácticas de seguridad de la información.

1.1 Antecedentes

1.1.1 La necesidad de contar con una Guía de Orientación de Seguridad para la Implantación de Redes IP viene del programa de trabajo del Grupo de Tarea ATN del antiguo Subgrupo ATM/CNS del GREPECAS (Grupo de Planificación .y Ejecución de las Regiones del Caribe y Sur América) Un primer documento inicial de la guía de orientación de seguridad para la implantación de redes IP fue presentado en la Primera Reunión de Coordinación del Proyecto de Aplicaciones Tierra Tierra y Tierra Aire de la ATN del Subgrupo CNS/ATM del GREPECAS (Lima Perú del 19 al 20 de mayo de 2010). El Subgrupo CNS/ATM reemplazaba el Subgrupo ATM/CNS.

1.1.2 La Decimo Sexta Reunión del GREPECAS (Punta Cana República Dominicana del 28 de marzo al 1 de abril de 2011) aprueba una nueva organización para el GREPECAS desactivando todos los Subgrupo (Organos contributorios del GREPECAS) transformándolo en Programa y Proyectos (Decisión 16/45 y 16/47)

1.1.3 Todas las tareas relacionadas con la ATN incluyendo la elaboración de una guía de orientación seguridad IP fueron incluidas en el Proyecto D1 Arquitectura ATN SAM cuyo principal entregable es la implantación de la nueva arquitectura de red digital para la Región SAM que reemplazará la actual REDDIG.

1.1.4 El seguimiento de la implantación de las actividades del proyecto D1 se está llevando a cabo en las Reuniones del Grupo de Implantación SAM (SAM/IG) y sometidas a la revisión del Grupo de Coordinación de Programas y Proyectos del GREPECAS cuya primera Reunión (CRPP/1) se llevó a cabo en Ciudad de México del 25 al 27 de abril de 2012.

1.1.5 En referencia a la preparación de una guía de orientación de seguridad para la implantación de Redes IP, la Reunión SAM/IG/10 (Lima Perú del 1 al 5 de octubre) consideró la importancia de completarlas la guías de orientación de seguridad para la implantación de redes IP y de presentar la misma para la reunión SAM/IG/11.(13 al 17 de mayo de 2013) .A este respecto la Sexta Reunión del Comité de Coordinación del Proyecto RLA/06/901 (Lima Perú xxxx) aprobó la contratación de un experto a fin de preparar dicho documento.

1.2 Organización del Documento

1.2.1 Este documento posee 4 capítulos, que comprenden la siguiente información :

Capitulo 1 contiene información introductoria de la guía de orientación y está descrita en la sección 1.1 del documento.

Capítulo 2 provee una descripción de los más importantes aspectos de seguridad de la información, con algunos conceptos contenidos en las Normas ISO/IEC 27000, que presentan la seguridad como un proceso, que requiere la existencia de un sistema de gestión.

Capítulo 3 hace un amplio abordaje de las redes que componen la ATN SAM, con énfasis en la REDDIG II y sus interconexiones con las redes de los Estados de la Región SAM, así como en las aplicaciones que la utilizan.

Capítulo 4 presenta las prácticas de seguridad involucradas con los aspectos gerenciales, operacionales y técnicos. Estas prácticas intentan el establecimiento de controles de seguridad, los ceuales son implementados por medio de dispositivos tecnológicos y por procedimientos.

2 SEGURIDAD DE LA INFORMACIÓN

2.1 Introducción

2.1.1 La situación actual que está viviendo a la humanidad puede ser caracterizada como la Era de la Información, en que los sistemas están altamente conectados en red, creando, procesando y distribuyendo la información en gran cantidad y velocidad.

2.1.2 Con el desarrollo de nuevas tecnologías, centrándose en el uso intensivo de las redes informáticas y de comunicación, el mundo se ha vuelto más pequeño generando una sociedad global basada en la información y conectada por redes complejas e interconectadas, haciendo uso la información como un activo de alto valor económico. Un entorno donde la información viaja a velocidades crecientes y se accede por los diversos dispositivos y medios de comunicación, se utilizan para diversos fines, generando nuevas informaciones que, a su vez, incrementan nuevos negocios, en un ciclo de crecimiento económico y social. Hubo un cambio de paradigma, de lo analógico a lo digital.

2.1.3 En este contexto, donde la información tiene un valor económico y estratégico para las organizaciones y está disponible en cualquier momento en diferentes dispositivos conectados a la Internet, surge la necesidad de contar con mecanismos protectores que garanticen su disponibilidad, integridad, autenticidad y confidencialidad, entre otros requisitos de seguridad de la información.

2.1.4 Se puede así decir que Seguridad de la Información representa el área de conocimiento dedicada a la protección de los activos de información contra el acceso no autorizado, alteración indebida o su falta de disponibilidad.

2.1.5 Según la Norma ISO/IEC17799:2005, la información es un activo esencial para los negocios de una Organización y como tal debe ser protegida de forma adecuada, especialmente en los ambientes de negocio de hoy en día, los cuales son altamente interconectados, exponiendo la información a una gran variedad de amenazas y ataques.

2.1.6 La información está disponible en distintas formas, sea impresa, hablada o en medios electrónicos , enviada por correo electrónico, por ejemplo, y almacenada en discos magnéticos o otros dispositivos de almacenamiento. Lo que importa es la necesidad de protección de todos los tipos de información para garantizar los negocios de la Organización.

2.1.7 Por lo tanto, se puede caracterizar la seguridad de la información como la protección de toda información contra las amenazas y garantizar la continuidad de los negocios, la mitigación de los riesgos, la maximización del retorno de los investimentos (ROI) y posibilitar nuevas oportunidades de negocio.

2.1.8 En este contexto, la seguridad de la información es obtenida a partir de un conjunto de controles, que incluyen políticas, procesos, procedimientos, estructuras organizacionales y funciones de *hardware* y *software*.

2.1.9 Como es una actividad dinámica, con nuevas amenazas que aparecen cada día, es adecuado que sea tratada con una visión sistémica, basada en principios de gestión de procesos, ejecutando todo el ciclo PDCA (*Plan, Do, Check, Act*), buscando, siempre, la mejora continua de todo el sistema.

Fig. 1 – El Ciclo PDCA

2.1.10 La definición de los controles de seguridad son basadas en requerimientos legales y en las mejores prácticas del mercado. En el punto de vista de la legalidad, los controles esenciales, básicos, incluyen:

- La protección de los datos y la privacidad de las informaciones personales;
- La protección de registros organizacionales; y
- Derechos de propiedad intelectual

2.1.11 Los controles asociados a las mejores prácticas de mercado incluyen:

- El documento conteniente la política de seguridad de la información;
- La atribución de responsabilidades;
- La educación, concientización y entrenamiento en seguridad da información;
- El procesamiento correcto en las aplicaciones;
- La gestión de las vulnerabilidades técnicas;
- La gestión de la continuidad del negocio; y
- La gestión de incidentes de seguridad de la información y mejoras.

2.2 Conceptos Básicos

2.2.1 Para mejor comprensión de los aspectos involucrados a la seguridad de la información, se presentará a continuacion algunos conceptos básicos, basados en las Normas ISO/IEC 27000:2007.

- **Activo:** se considera cualquier cosa que tenga valor para la Organización. Por lo tanto, cada Organización determinará que es importante y necesario proteger.
- **Amenaza:** se pude definir como la causa potencial de un incidente no deseado que pueda causar daño en un sistema o Organización. También cualquier persona, entidad, software malicioso, que pueda tener motivación para explorar una vulnerabilidad.

- **Vulnerabilidad:** Es una fragilidad de un activo que puede ser explorada por una o más amenazas.

- **Probabilidad del Riesgo:** Se caracteriza pela posibilidad de una amenaza explorar alguna vulnerabilidad y comprometer uno o más principios de la seguridad.

- **Impacto:** Es el grado del daño que pueda ser causado a un activo cuando una amenaza potencial explora una vulnerabilidad. Es relativo, pues depende de la percepción de valor de la información por sus propietarios.

- **Criticidad del Riesgo:** Consiste en la evaluación combinada de la probabilidad del riesgo ocurrir y de su impacto. La criticidad depende de tres factores: de las amenazas y probabilidades – que determinan la probabilidad del riesgo – y del impacto. Con la criticidad definida es posible establecer los controles de seguridad para la protección del activo.

- **Riesgo:** Es la combinación de la probabilidad de un evento y de sus consecuencias.

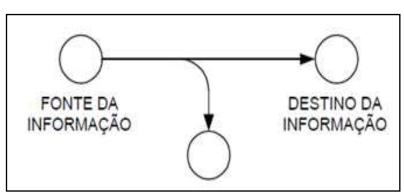
- **Incidente:** una o más serie de eventos de seguridad de la información no deseados o no esperados, que tengan una gran probabilidad de comprometer las operaciones del negocio y amenazar la seguridad de la información.

- **Evento:** es una ocurrencia identificada de un estado del sistema, servicio o red, que indica una posible violación de seguridad de información, la falta de controles o una situación previamente desconocida que puede ser relevante para seguridad de la información. Tome nota de que un evento de seguridad de la información es cualquier cosa que merezca investigación por parte de los responsables de seguridad de la información. Sin embargo no todo evento es un incidente de seguridad de la información.

2.3 Principios de Seguridad de la Información

2.3.1 Según la Norma ISO/IEC 27002:2007, las más importantes propiedades de la información, también llamados de principios de seguridad de la información, qué necesitan de preservación son:

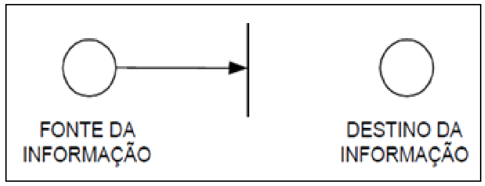
- **Confidencialidad:** capacidad de un sistema de impedir que usuarios no autorizados tengan acceso a determinada información que fue delegada a solamente usuarios autorizados. La pérdida de la confidencialidad puede ser obtenida por medio de la interceptación. La figura siguiente ilustra dicha situación:



Fuente: SANTOS (2011)

Fig. 2– Pérdida de la Confidencialidad

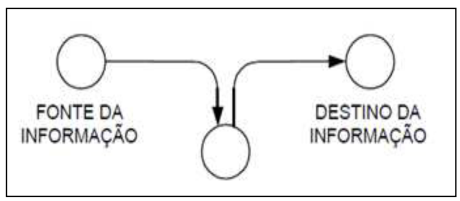
- **Disponibilidad:** indica la cantidad de veces que el sistema cumplió una tarea solicitada sin fallas internas, para un número de veces en que fue solicitado a hacer la tarea. La pérdida de la disponibilidad pode ocurrir por media de una interrupción.



Fuente: SANTOS (2011)

Fig. 3 – Pérdida de la Disponibilidad

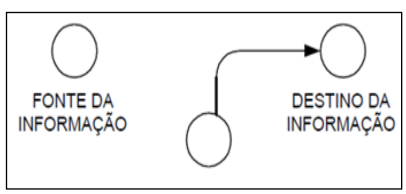
- **Integridad:** atributo de seguridad que indica si una información puede ser alterada solamente de forma autorizada. La pérdida de la integridad puede ocurrir por modificación.



Fuente: SANTOS (2011)

Fig. 4 – Pérdida de la Integridad

- **Autenticidad:** capacidad de garantizar que un usuario, sistema o información es el mismo que se dice ser; e



Fuente: SANTOS (2011)

Fig. 5 – Pérdida de la Autenticidad

- **No rechazo:** o no repudio, es la capacidad del sistema proveer pruebas de que un usuario ejecutó una acción en el sistema. Por lo tanto, el usuario no puede negar la autoría de la ejecución.

2.4 Escenario Actual

2.4.1 La dinámica del mundo moderno impone a los administradores de los sistemas de información una serie de amenazas, que pueden impactar de forma significativa en los negocios de las Organizaciones. Tales amenazas buscan explorar las vulnerabilidades existentes en las redes y en las aplicaciones. Por lo tanto, es importante conocer las amenazas, pero es mucho más importante que se conozcan las vulnerabilidades y que se aplique los controles para mitigar dichas vulnerabilidades.

2.4.2 El escenario actual es influenciado por las características de las modernas redes, de entre las cuales si destacan:

- **Automatización:** las redes de hoy son altamente interconectadas lo que cambió la forma de actuación de los ataques, lo que ocurren de forma distribuida, con el uso de miles de computadoras para hacer en minutos algo que tomaría años en un solo equipo. Un ejemplo es la ruptura de la encriptación DES (*Data Encryption Standard*) antes de lo previsto.

Fig 6 – La automatización multiplica el poder del atacante

- **Acción Remota:** El avance de la interconexión de las redes eliminó barreras físicas y acortó distancias, posibilitando que un ataque sea comandado a miles de distancia del activo atacado, o que dificulta la identificación e la toma de acciones punitivas, por involucrar aspectos jurídicos de diferentes Estados.

- **Anonimato:** La sensación de anonimato, de se estar invisible", atrae a los chicos malos para la práctica de actos criminosos, o que resulta en un gran cuantidad de ataques, de distintos propósitos.

- **Colaboración:** Hoy día es mucho sencillo compartir informaciones, por medio de las redes interconectadas. Esto posibilita la divulgación, rápida y de gran alcance, de vulnerabilidades existentes en redes, aplicaciones y sistemas operativos y, a partir de ellas, alguna persona desarrollar una aplicación que explora una determinada vulnerabilidad (un *exploit*) y difundirla para todos.

2.5 Amenazas, Ataques y Vulnerabilidades

2.5.1 Vulnerabilidades son fragilidades presentes en sistemas de información, procesos, equipamientos y redes, que pueden causar impactos a las organizaciones, afectando sus negocios.

2.5.2 Según el CERT, de la *Carnegie Mellon University*, 99% de los casos de intrusión a redes son el resultado del ataque en contra de vulnerabilidades conocidas o errores de configuración solucionables. Ya la empresa Secunia publicó un reporte conteniendo las 6 más importantes clases de impactos ocurridas en la mitad del 2010, presentadas a seguir:

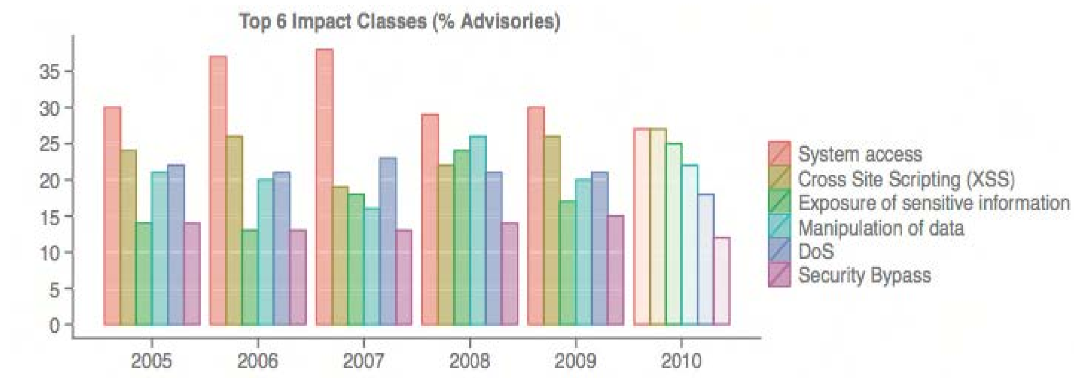


Figure 5 Distribution and evolution of the six most prevalent impact classes since 2005. The plots include a linear extrapolation for 2010 based on the data of the first half of 2010.

Fuente: Secunia - Half Year Report, 2010.

2.5.3 Las vulnerabilidades pueden ser clasificadas en los siguientes tipos:

- Física: son aquellas asociadas a las instalaciones, como controle de acceso, energía, climatización, incendios, inundación, etc.

- Hardware y Software: están relacionadas a fallas en los equipamientos y en las aplicaciones.

- Comunicación: involucran las fragilidades relacionadas a los sistemas de comunicación de datos; y

- Humana: están relacionadas a las fragilidades en concientización, capacitación y formación de los técnicos y operadores de los sistemas y equipamientos.

2.5.4 Los ataques exploran las vulnerabilidades con el objetivo de causar daño a alguna organización, afectando un o varios dos principios de seguridad de la información, sea para interrumpir su operación, sea para obtener información estratégica o para modificar un documento financiero. A seguir se presentan algunos daños:

- Acceso no autorizado a la red;

- Exposición de información confidencial;

- Daño o distorsión de la información;

- Proveer de datos para el hurto o secuestro de identidad;

- Exponer secretos organizacionales;

- Desencadenar fraudes;

- Paralizar las operaciones del negocio; y

- Desencadenar accidentes con riesgo de vidas.

2.5.5 Los ataques pueden ser hechos en los datos, en las líneas de comunicación (redes), en el *hardware* y en el *software*.

- Datos: ataques a los datos afectan los siguientes principios de seguridad: confidencialidad, integridad, autenticidad y no repudio;
- Redes: ataques a las redes afectan los siguientes principios de seguridad: disponibilidad, confidencialidad y integridad;
- *Hardware*: ataques al hardware afectan principalmente el principio da disponibilidad; y
- *Software*: ataques al software afectan los siguientes principios de seguridad: confidencialidad, integridad, autenticidad.

2.5.6 La tabla siguiente presenta un resumen de los tipos de amenazas a los principios de seguridad:

AMENAZA	**PRINCIPIO DE SEGURIDAD**			
	DISPONIBILIDAD	**INTEGRIDAD**	**CONFIDENCIALIDAD**	**NO REPUDIO**
HARDWARE	Robos de equipamientos Desactivación Interrupción de energía Incendio Inundación Aquecimiento	NA	NA	NA
SOFTWARE	Programas apagados	Modificación de un programa en ejecución	Copia no autorizada	Archivo de *logs* apagado
DATOS	Archivos apagados	Creación de nuevos archivos Modificación de archivos existentes	Acceso no autorizado	Modificación de las propiedades del archivo
REDES	Mensajes apagadas o destruidas	Mensajes modificadas	Acceso no autorizado a mensajes	Archivo de *logs* apagado

Tabla 1 – Amenazas a la Seguridad

2.5.7 Los atacantes pueden ser externos o internos a la Organización. Los externos hacen uso de las conexiones externas de las redes de la organización. Ya los internos tienen acceso directo a los sistemas, redes, hardware y datos de la organización.

2.5.8 Básicamente, un ataque es hecho en dos etapas:

- Búsqueda por vulnerabilidades; y
- Exploración de las vulnerabilidades.

2.5.9 Por lo tanto, es importante conocer algunas técnicas de recolección de informaciones e utilizadas por los atacantes, así como algunas aplicaciones que exploran dichas vulnerabilidades.

1. Técnicas de Recolección de Informaciones

2.5.10 Existen hoy día varias técnicas para recolección de informaciones cerca de la infraestructura de las redes e de los sistemas de información. Serán listadas algunas de ellas, las más comunes, a saber:

- **Ingeniería Social:**

2.5.11 Es una técnica que no requiere muchos conocimientos de redes y de aplicaciones, ya que usa la persuasión, explorando la ingenuidad o la confianza del usuario para obtener informaciones que pueden ser importantes para la violación de la seguridad de un sistema. El foco de la atención del atacante son, por lo tanto, las personas y no la tecnología.

- ***Phishing*:**

2.5.12 La idea de esta técnica es la obtención de informaciones por medio del envío de mensaje no solicitada por la víctima, intentando de hacer que la comunicación sea una información legítima de una institución financiera conocida, un órgano del gobierno, una empresa multinacional o un sitio popular. Asociado a ella, sigue un link que direcciona para un sitio falso muy parecido con el sitio de la institución, llevando el usuario a suministrar datos como su l*ogin* y *password*.

- ***Packet Sniffing*:**

2.5.13 Son herramientas de software instaladas en equipos conectados a una red, en modo promiscuo, que permiten la captura de datos existentes en los paquetes de las mensajes tramitadas por la red.

2.5.14 Esta técnica de recolección también es utilizada por los administradores de las redes, como forma de analizar su desempeño, siendo conocidos como analizadores de protocolos.

2.5.15 La búsqueda por vulnerabilidades es hecha por herramientas de *software* que identifican las características de las aplicaciones y sistemas más utilizados en las organizaciones. La técnica consiste e la obtención de respuestas suministradas por el sistema para algunas interrogaciones hechas por el *scanner*. Se puede obtener, por ejemplo:

2.5.16 Es una técnica utilizada por los atacantes para la búsqueda de informaciones cerca de los servicios disponibles en una red o sistema, por medio de las puertas de comunicación utilizadas por los protocolos de comunicación, a ejemplo del TCP/IP.

2.5.17 Conociendo una puerta abierta, el atacante pude invadir la red y obtener la información o interrumpir la operación de una red o sistema. No hay como impedir la identificación de las puertas abiertas, pues la técnica consiste en el envío de solicitaciones de conexión, similar a una solicitación de un usuario legítimo de la red.

- ***Scanning* de Vulnerabilidades**

2.5.18 La búsqueda pro vulnerabilidades es hecha por herramientas de *software* que identifican las características de las aplicaciones y sistemas más utilizados en las organizaciones. La técnica consiste e la obtención de respuestas suministradas por el sistema para algunas interrogaciones hechas por el *scanner*. Se puede obtener, por ejemplo:

- Tipo y versión de sistema operativo;
- Fabricante de la interfaz de red;
- Dirección de red (IP) o de enlace (MAC);
- Puertas de comunicación abiertas;
- Versiones de software; y
- *Passwords defaults* en los activos de red y de seguridad.

2. *Exploits* o códigos maliciosos

2.5.19 Más conocidos como *malwares*, son los software que inician la secuencia de eventos para la exploración de vulnerabilidades y el consecuente comprometimiento de la red o sistema.

2.5.20 Algunos *malwares* son presentados a seguir:

- **Virus**

2.5.21 Es un programa de computadora que infecta una máquina por medio de la ejecución de un software legítimo pero infectado. Por lo tanto, un virus depende de otro software para infectar la máquina y difundir.

- ***Worm***

2.5.22 Es un programa que se propaga automáticamente en las redes y que no necesita de ejecución explícita por un usuario o por un software. Así, no hay dependencia de otro software para infectar la máquina. Una característica de los *worms* es que consumen muchos recursos de la red y de los sistemas.

- ***Spyware***

2.5.23 Son códigos maliciosos que poseen el objetivo de recolectar informaciones digitadas en formularios *web*, sitios visitados en la Internet, etc. O sea, son técnicas de recolección de datos pero necesitan de infección hecha anteriormente por un *malware*.

- ***Loggers***

2.5.24 Básicamente son software que capturan informaciones en computadoras.. Existem los *keyloogers*, que capturan las teclas digitadas en una computadora, y los *screenloggers*, que capturan la imagen de la pantalla (screen).

- ***Trojans***

2.5.25 Son programas que se presentan como algo de útil para el usuario pero contienen códigos maliciosos.

- ***Exploits***

2.5.26 Programas (o *kits* de programas) que tornan fácil la exploración de vulnerabilidades conocidas de sistemas operativos y aplicaciones. No requiere muchos conocimientos de redes o de sistemas de información.

2.5.27 En secuencia, serón descritos algunos ataques de denegación del servicio:

- ***IP spoofing***

2.5.28 El ataque de *spoofing* es basado en una situación en que una entidad loga pasar con éxito por otra. En el caso de IP *spoofing*, el atacante puede falsificar una dirección IP de origen con el envío de paquetes IP de origen diferente de su propia dirección IP, haciéndose pasar por otra máquina. La falsificación de direcciones IP se utiliza principalmente en los ataques de denegación de servicio, donde el atacante necesita que muchas de las respuestas se envían no a él sino a la máquina que desea atacar.

- ***DNS spoofing***

2.5.29 En este ataque el servidor DNS utilizado por el host blanco del ataque es invadido y su información cambiada a asignaciones incorrectas entre nombres y direcciones. Así, cada vez que una aplicación de usuario utiliza un nombre particular que ha sido cambiado, él se comunicará con una entidad falsa. Por ejemplo, si la dirección IP de una página ha cambiado en DNS, el navegador redirige al usuario a la página falsa sin reporte de que dirección está en uso (para eso sirven DNS, navegadores, etc.) El servidor que hospeda esta página falsa está preparado por el atacante para robar información del usuario sin que él se diera cuenta.

- ***ARP spoofing***

2.5.30 El ARP *spoofing* es una técnica de suplantación de identidad en el que un atacante intenta suplantar a un destinatario legítimo de la comunicación en respuesta a consultas ARP enviadas por la fuente de tráfico. La respuesta del atacante se envía dentro del dominio de *broadcast* antes de que el destinatario tiene una legítima oportunidad de hacerlo. Así, tanto el equipo de origen como el *swicth* aprenden un mapeo falso entre la dirección MAC (el atacante) y la dirección IP (el destino legítimo). De esto, todos los *frames* están encapsulados por el origen con la dirección MAC del atacante y se conmutan mediante el *switch* en la puerta donde el atacante esta basado en el MAC.

- ***Dos***

2.5.31 Dos (*Denial of Service*) es un ataque que tiene el objetivo de interrumpir la disponibilidad de un determinado servicio, sistema o red. Muchas de las técnicas utilizadas son conocidas como *flooding (*inundación*)* y sus blancos son los servidores utilizados por varios usuarios, como DNS y de páginas *web*.

2.5.32 Una ampliación del poder de este tipo de ataque es el DDOS (*Distributed Denial of Service*), donde el atacante hace uso de varias máquinas (miles) para atacar un determinado servicio, servidor o sistema.

3 LA ATN SAM

3.1 Introducción

3.1.1 El concepto CNS/ATM de la OACI considera que los nuevos servicios serán soportados por la ATN (*Aeronautical Telecommunications Network*), que engloba las redes regionales. En el caso de la Región SAM, la ATN SAM es compuesta por una red digital regional, la REDDIG II, y las redes de cada Estado.

3.1.2 Para cumplir con los requerimientos operacionales, la REDDIG II fue concebida con dos *backbones*, uno satelital y otro terrestre, y debe asegurar:

a) Disponer de dispositivos de ruteo, equipos y enlaces satelitales, como asimismo servicios terrestres, con todas las interfaces de canal con que hoy cuenta la red actual (REDDIG), adicionando las necesarias para el soporte de los futuros servicios basados en el concepto CNS/ATM;
b) La aplicación generalizada del protocolo IP en la red de transporte para las comunicaciones aeronáuticas de voz y datos;
c) El establecimiento de parámetros de calidad de servicio adecuados;
d) Mantener los servicios analógicos en aquellos casos que aun sean necesarios (AFTN, datos radar de equipos antiguos, etc.);
e) Mantener la conexión a la red MEVA II;
f) Mantener una administración centralizada y común para la red;
g) Mantener el alto grado de disponibilidad alcanzado por la actual REDDIG;
h) Ser el medio de integración regional de los sistemas de redes nacionales desarrolladas por los Estados de la Región; y
i) Dar soporte a las comunicaciones regionales de una manera costo-eficiente, y con alta confiabilidad, disponibilidad y mínimo retardo.

3.1.3 Las características mínimas de la REDDIG II son:

- Accesos satelitales y terrestres;
- Topología mallada, flexible, multiprotocolo, multiservicio y de área externa;
- Ser escalable y de fácil expansión;
- Redundancia y encaminamientos satelitales y terrestres;
- Ser de arquitectura abierta, basada en protocolo IP;
- Permitir la migración a otras tecnologías de redes;

3.1.4 Se observa la definición del protocolo IP para la implantación de la nueva REDDIG, así como la existencia de dos *backbones*, uno terrestre y otro satelital, con redundancia de equipamientos garantizando alta confiabilidad, disponibilidad y mínimo retardo.

3.1.5 Otra característica importante es la compatibilidad con protocolos y servicios existentes en la actual REDDIG, incluyendo los servicios analógicos, a ejemplo de la AFTN.

3.1.6 La red satelital está proyectada para operar con el protocolo TCP/IP bajo la administración de los Estados da Región SAM y operada por la OACI, mientras la red terrestre está proyectada para uso del MPLS y es un servicio prestado por una empresa privada.

3.1.7 Estudios realizados por los expertos apuntan para una disponibilidad de 99,999985002% de la rede mixta (satelital y terrestre), correspondiendo a una indisponibilidad mensual de 0,02 min/mes.

3.1.8 Las figuras siguientes presentan de forma esquemática la topología proyectada para la REDDIG II:

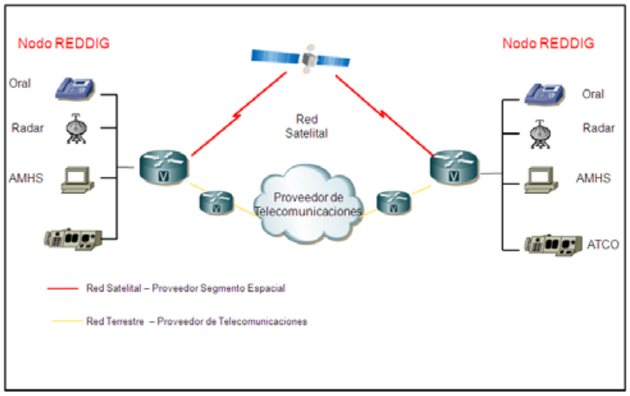


Fig 8 – La REDDIG II – Topología

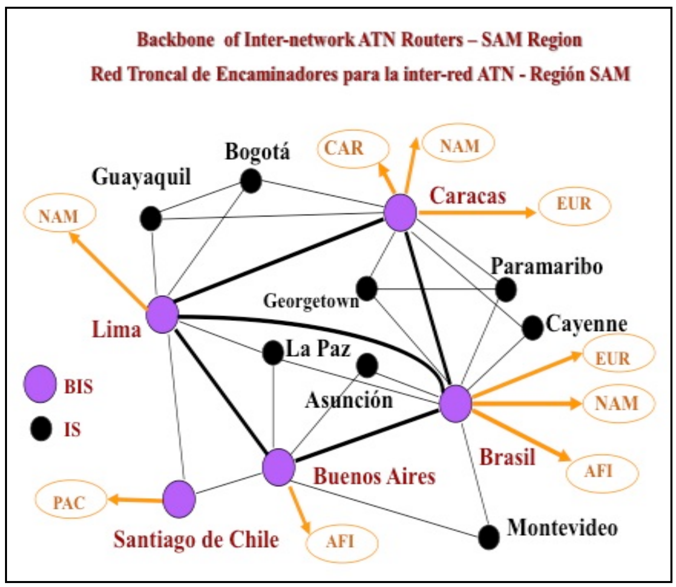


Fig 9 – La REDDIG II – Puntos de Interconexión

3.2 Servicios de la ATN

3.2.1 La lista de requerimientos de servicios para el apoyo a la navegación aérea en la región SAM, incluyendo los previstos a corto, mediano y largo plazo, a ser transportados por la REDDIG II se compone de los:

a. Servicios actuales:

3.2.2 Los que surgen de los requisitos contenidos en el Plan de Navegación Aérea de las Regiones del Caribe y de Sudamérica, y que a la fecha se encuentran operativos en su casi totalidad, a saber:

- Tabla CNS1A (Plan AFTN); y

- Tabla CNS1C (Plan de circuitos orales directos ATS).

b. Servicios futuros:

- Los que surgieron de la interconexión MEVA II – REDDIG;
- El Servicio de Teleconferencia para las unidades de gestión de flujo (FMU) o puestos de gestión de flujo (FMP), a realizarse en forma diaria entre todas las unidades de la Región, inicialmente para veinte usuarios;
- El Intercambio de planes de vuelo y/o información radar, por los métodos convencionales, de acuerdo a los respectivos MoU (Memorandos de Entendimientos) suscriptos o a subscribirse;
- Los requerimientos de interconexión AMHS, reemplazando progresivamente el servicio AFTN, de acuerdo a los respectivos MoU (Memorandos de Entendimientos) suscriptos o a subscribirse;
- Los requerimientos de interconexión AIDC, reemplazando progresivamente el servicio Oral ATS;
- El Intercambio de datos ADS-B y multilateración, entre todos los ACCs de FIRs colindantes;
- La Interconexión de sistemas automatizados utilizando Asterix 62 y 63, entre todos los ACCs de FIRs colindantes.
- Los requerimientos AIM: respecto a este particular, a la fecha no se dispone de un requerimiento concreto;

3.3 Características Técnicas del Sistema de Ruteo (SR)

3.3.1 Desde el punto de vista de la seguridad de la información, uno de los activos más importantes de la REDDIG II son los enrutadores, los cuales poseen las siguientes características técnicas:

- La cantidad mínima necesaria de memoria que atienda a todas las funcionalidades exigidas,en conformidad a las recomendaciones del fabricante.
- Protocolo de gerenciamiento SNMP y MIB-II implementados en conformidad con la RFC 1157 y con RFC 1213, respectivamente.
- Funcionalidad de Gateway para voz sobre IP que atienda a todas las funcionalidades requeridas.
- Las características necesarias para la implementación de los protocolos RTP/RTCP e RTP “header compresión” en conformidad con la RFC 2508.

3.3.2 Los enrutadores permiten:

- Priorización de tráfico por tipo de protocolo y por servicios de la pila de protocolos TCP/IP.

- La utilización de protocolo que viabilice el establecimiento de clases de servicio, con reserva de banda, para garantía de priorización de aplicaciones críticas, en conformidad con estándares IP definidos (RFCs).

- La interoperabilidad, inclusive para VoIP, con enrutadores Cisco de los más variados tipos, ya existentes en los nodos de la REDDIG.

- Disponer de funcionalidad de acceso remoto, que permita como mínimo cinco (5) conexiones simultáneas, con la utilización de claves de diferentes niveles, que posibiliten restricciones a la configuración de los equipos y a comandos que alteren su funcionamiento.

- Estar interconectado con el sistema de enrutamiento del proveedor de servicio terrestre.

- Poseer manejo del enrutamiento alterno para el backbone MPLS terrestre automático en caso de falla.

- Tener capacidad de técnicas de compresión de encabezamiento, aceleración TCP y balance de carga.

- Disponer todos los ports necesarios para satisfacer los requerimientos actuales y futuros.

- Establecer comunicaciones permanentes y conmutadas para voz y datos. Las comunicaciones conmutadas se establecerán a solicitud del usuario.

- Establecer grupos cerrados de usuarios para tráfico telefónico y datos.

- Incluir una métrica que permita establecer de manera automática los caminos que proporcionen el mínimo retardo a las comunicaciones dentro del ancho de banda disponible en la red.

- Incluir las facilidades para la definición de los circuitos, direccionamientos, velocidades de transmisión y priorización del tráfico con la aplicación de calidad de servicio (QoS).

- Establecer redes privadas IP (VPN), e interconectarse con las redes públicas.

- Incluir los elementos necesarios para sincronizar la red.

- Estar integrada al sistema de gestión de red (NMS).

3.3.3 Implementan los protocolos de enrutamiento:

- RIPv1 (RFC 1058).

- RIPv2 (RFCs 2453, 1723 e 1724).

- EIGRP.

- OSPF versión 2 de acuerdo con las siguientes RFCs (RFC 2328, RFC 1793, RFC 1587 e RFC 2370).

- BGPv4 conforme RFCs 4271, 4272 4360, 4374, 4451, 4456, 1966, 1997, 2796, 2439, 2858, 2918.

3.4 Tolerancia a fallos y recuperación

3.4.1 La arquitectura del backbone satelital de la REDDIG II y los sistemas que componen el suministro fue proyectada para ser tolerante a fallas, no existiendo ningún elemento común cuya falla provoque el cese de los servicios que presta la red. Una eventual falla solo puede producir una degradación gradual de los servicios que presta la red. La figura a seguir presenta el esquema general de tolerancia a fallas:

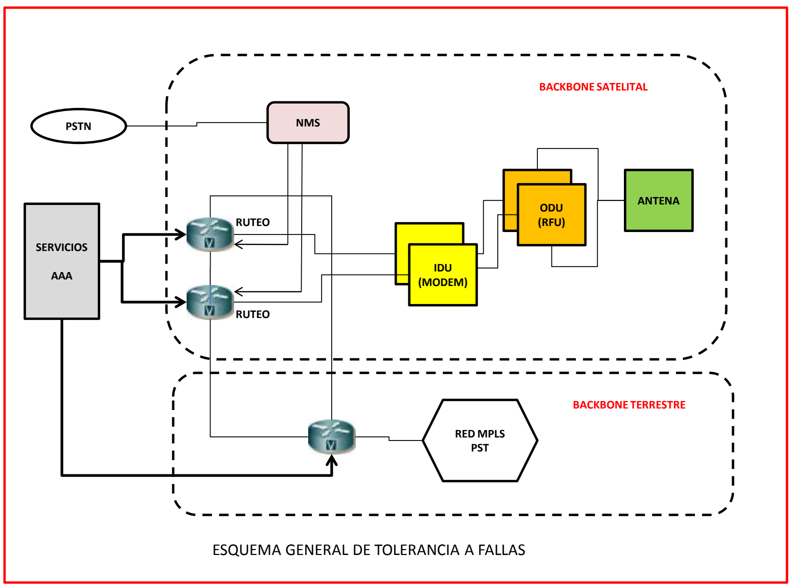


Fig 10 – Tolerancia a Fallas

3.5 Red de Acceso

3.5.1 El backbone terrestre será próvido por una empresa privada y poseerá una disponibilidad mensual mínima de 99,5%, con un retardo inferior a 60 ms y una tasa de error inferior a 10-7 para el 99,5% del tiempo. Actuará como una infraestructura multiservicios y deberá ser provisto por una Plataforma IP Multiservicios, lógicamente independiente y aislada de cualquier otra red y, en especial, del ambiente público de la Internet. Esta red permitirá la creación de VPN y la implementación de QoS.

4 PRÁCTICAS DE SEGURIDAD PARA LA ATN SAM

4.1 Objetivos de Seguridad

4.1.1 Para atender los requerimientos operacionales de los servicios ATM, la ATN requiere el atendimiento de los siguientes objetivos fundamentales de seguridad:

1. Protección de los datos de la ATN en contra acceso no autorizado, modificación o apagado;
2. Protección de los activos de la ATN en contra uso no autorizado y negación de servicio.

4.1.2 Tales objetivos requieren el atendimiento de los siguientes principios de seguridad de la información, anteriormente descritos, pero con distintos grados de relevancia:

- Integridad;
- Disponibilidad;
- Confidencialidad;
- Autenticidad;
- No repudio; y
- Responsabilidad.

4.1.3 Tomando como ejemplo la característica intrínseca de la aviación civil, en que es mui importante el acceso por todos los involucrados a las informaciones de un vuelo, la confidencialidad nos es tan crítica cuanto la integridad y la disponibilidad. Por lo tanto, las medidas de seguridad, o controles, deben recomendar la implantación de acciones tales que garanticen prioritariamente dichos principios, cuando de la analice costo/beneficio de cada acción. O sea, el esfuerzo de protección debe ser proporcional y adecuado a las necesidades de protección. Para esto, es importante tener en cuenta la criticidad de los riesgos asociados a la actividad, conociendo las amenazas, sus probabilidades, las vulnerabilidades y los respectivos impactos.

4.1.4 La implementación de los principios de seguridad se hace por medio de una serie de controles de seguridad de la información, como preconizado pelas Normas ISO/IEC 27000, los cuales pueden ser organizados en:

- Controles Gerenciales;
- Controles Operacionales; y
- Controles Técnicos

4.1.5 La figura siguiente describe las relaciones entre objetivos de seguridad de la ATN, principios de seguridad, controles de seguridad y acciones de seguridad:

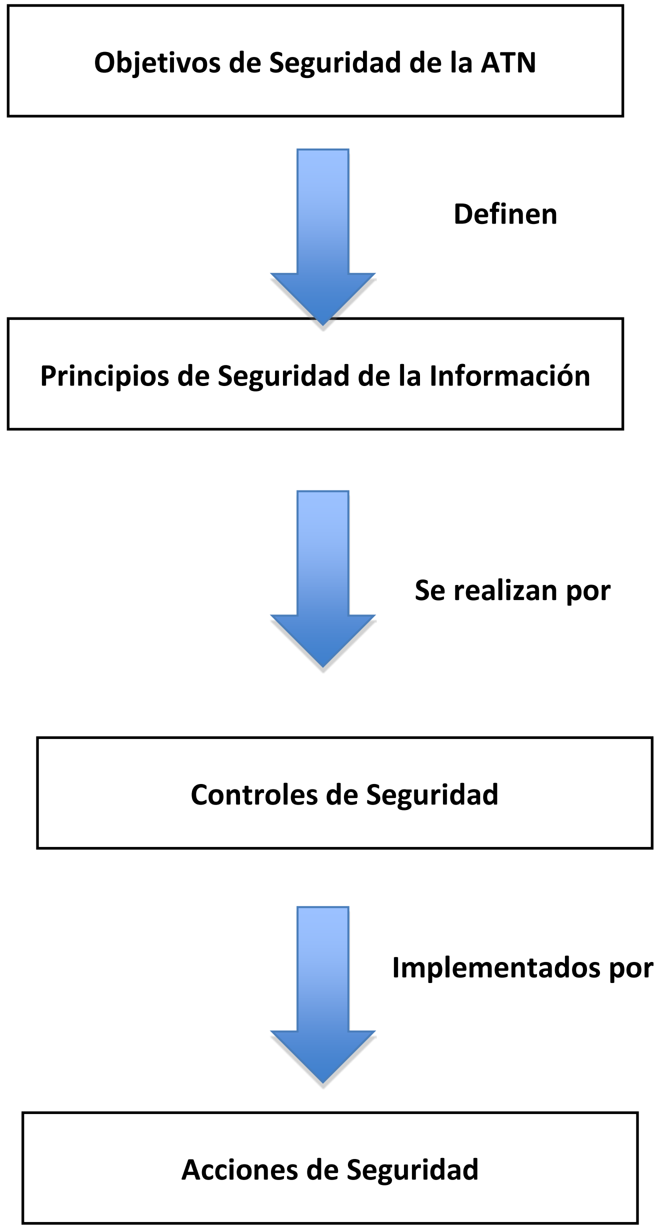


Fig 11– Objetivos de Seguridad

4.2 Estrategia de Seguridad

4.2.1 La estrategia de seguridad adoptada es basada en el concepto de "*Defense in Depth*", donde se implementan múltiples capas de seguridad, formando una estructura de defensa amplia que protege la información en contra los ataques. Su concepción está fuertemente apoyada en el uso intensivo de las técnicas y tecnologías existentes hoy día, con un equilibrio entre los costos, capacidad de protección, performance y aspectos operacionales.

4.2.2 Un punto importante de este concepto es el equilibrio entre los tres principales elementos de la seguridad de la información: Personas, Tecnología y Operaciones:

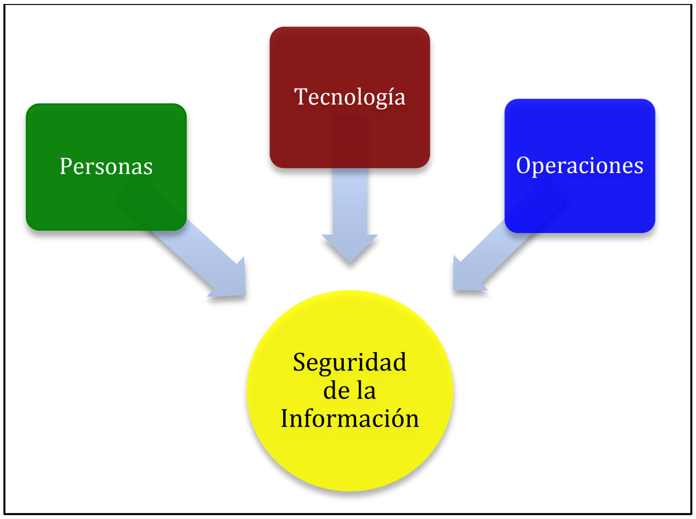


Fig 12– Elementos de la Seguridad

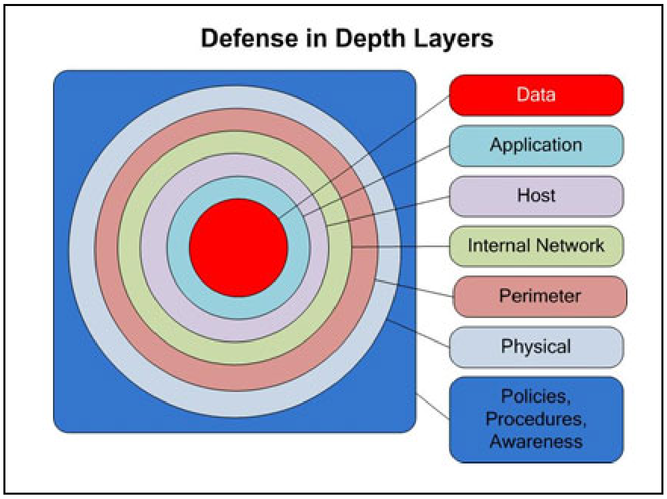
a) **Personas:** Involucra los aspectos relacionados al establecimiento de políticas y procedimientos para la definición de reglas y responsabilidades; la realización de entrenamientos para la creación de una mentalidad de seguridad tanto del personal técnico cuanto de los operadores, así como medidas de control de acceso físico a las instalaciones críticas.

b) **Tecnología:** Engloba el establecimiento de políticas y procesos para la adquisición de herramientas y productos de cualidad, así como la adopción de los siguientes principios:

- Defensa en múltiples áreas, con foco en la defensa de la red y de la infraestructura; defensa de las bordas y defensa del ambiente computacional;

- Incluir tanto medidas de detección cuanto de protección, con infraestructuras para detectar intrusiones y para analizar y correlacionar los resultados y reaccionar en consecuencia.

- Defensa en capas: consiste en implementar varios mecanismos de defensa o controles entre el enemigo y su objetivo. Cada uno de estos mecanismos debe presentar obstáculos únicos. La figura a seguir presenta este principio, con la visualización de las capas de datos, aplicación, equipamiento o *host*, red interna, red perimetral, ambiente físico y, involucrando todos, las políticas y procedimientos.



Fuente: www.personal.psu.edu

Fig 12 – Defensa en Capas

c) Operaciones: Se centra en todas las actividades necesarias para mantener una postura de seguridad de la organización en el día a día. Incluye:

- Manutención de la política de seguridad;
- Gestión de la actitud de seguridad;
- Evaluaciones de seguridad;
- Monitoreo;
- Detección, alarme y respuesta a ataques;
- Recuperación y reconstitución.

4.3 Controles de Seguridad

4.3.1 La implementación de la estrategia se hace por medio de los controles de seguridad, que se aplican a los tres elementos: personas, consideradas en el contexto de la gestión; tecnología y operaciones.

1) Controles Gerenciales:

1.1) Certificación, Acreditación y Evaluación de la Seguridad: garantiza que la administración de la Organización avalia los controles de seguridad en sus sistemas y autoriza la operación.

1.2) Planeamiento: garantiza la administración de la Organización desarrolla y implementa un plan de seguridad.

1.3) Gestión de Riesgos y Vulnerabilidades: garantiza que la administración de la Organización avalia los riesgos y la criticidad de los daños causados por un ataque.

1.4) Concientización y Entrenamiento: garantiza que los técnicos y operadores tengan conciencia de los riesgos de seguridad asociados a sus respectivas actividades, así como conozcan las políticas de seguridad aplicables a sus áreas de actuación y están debidamente entrenados para la ejecución responsable y correcta de sus actividades.

1.5) Adquisición de Sistemas y Servicios: garantiza que la administración de la Organización aloca los recursos necesarios a la adecuada protección de la información.

2) Controles Técnicos

2.1) Control de Acceso: es la capacidad de limitar el acceso a servicios y recursos solamente a las personas autorizadas, considerando, también lo que cada persona puede utilizar en un determinado recurso o sistema.

2.2) Identificación y Autenticación: es la capacidad de identificar y autenticar usuarios de un sistema u otros recursos.

2.3) Protección de las Comunicaciones: es la capacidad de monitoreo, control y protección de las comunicaciones.

3) Controles Operacionales

3.1) Gestión de la Configuración: garantiza que el control de los componentes del sistema, incluyendo hardware, software y los parámetros de adaptación del sistema.

3.2) Respuesta a Incidentes: garantiza el tratamiento adecuado a los incidentes de seguridad y los comunica a las respectivas autoridades.

3.3) Plan de Contingencia: garantiza que los operadores poseen un plan que garanta la continuidad de la operación para los usuarios y servicios más críticos y situaciones de emergencia.

3.4) Protección de Datos: garantiza la protección los datos y de las midias de almacenamiento del sistema.

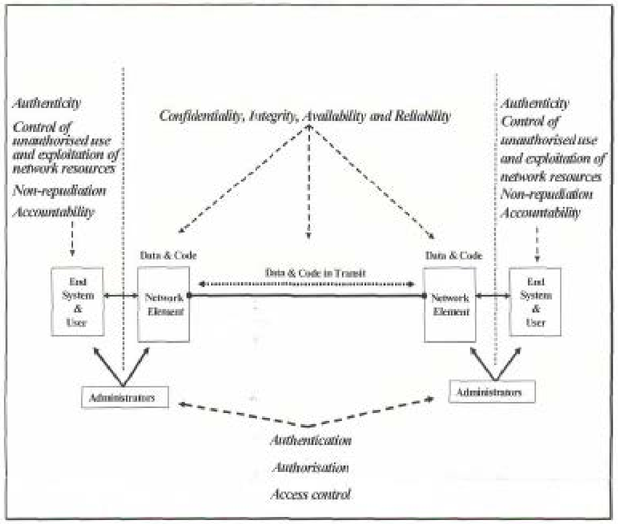
3.5) Protección de las Instalaciones: garantiza que los ambientes poseen acceso controlado.

4.4 Seguridad en las Redes

4.4.1 Considerando las capas de red interna y de borda de una Organización, así como de la REDDIG II, bajo la estrategia de defensa en capas, se describe a seguir algunos aspectos que toda Organización hay que tener en cuenta.

1- Toda organización debe planear, implementar y actualizar un plan de seguridad para las redes de su responsabilidad, teniendo en cuenta los objetivos de seguridad anteriormente descritos por esta guía;

2- Hay que tener implementado un proceso de gestión de riesgos para las redes, considerando el siguiente escenario, conforme la ISO/IEC 120-28-1:2006:



Fuente: ISO/IEC 18028-1:2006

Fig 13 – Áreas de Riesgo en Redes

3- Por lo tanto, hay que considerar las vulnerabilidades involucradas a las redes, con base en las siguientes posibilidades:

Network Facet	Types of Potential Network Security Vulnerability				
	Interruption	Interception	Modification	Intrusion	Deception
Network Users	Users may suffer loss or interruption of service.	User transactions and/or network activity may be monitored.	User details and user data may be modified or destroyed.	Users may be impersonated to gain unauthorized access to facilities.	Users may be impersonated to conduct fraudulent transactions.
Network End-Systems	End-systems may become temporarily or permanently unavailable.	Unauthorized persons may read data or code on end-systems.	Data or code may be modified or destroyed.	End systems may be impersonated to gain unauthorized access to facilities. Unauthorized persons might gain access to system accounts and use them to launch further attacks.	End systems may be impersonated to conduct fraudulent transactions, or to launch further attacks.
Networked Applications	Applications may become temporarily or permanently unavailable.	Data or code may be intercepted in transit, or read on servers, by unauthorized persons.	Data or code may be modified or destroyed.	Unauthorized persons might gain access to system accounts and use them to launch further attacks.	Unauthorized persons might gain access to system accounts and use them to launch further attacks.
Network Services	Services may become temporarily or permanently unavailable.	Data or code may be intercepted in transit, or read on servers, by unauthorized persons	Data or code may be modified or destroyed.	Unauthorized persons might gain access to system accounts and use them to launch further attacks.	Network servers and devices may be impersonated to gain unauthorized access, to intercept network traffic, or to disrupt network services.
Network Infrastructure	Facilities may become temporarily or permanently unavailable			Unauthorized persons may infiltrate facilities.	

Fuente: ISO/IEC 18028-1:2006

Tabla 2 –Vulnerabilidades en Redes

4- La administración debe garantizar la adquisición de adecuada de los recursos necesarios a la protección de la información, incluyendo los activos de red (enrutadores, switches, etc) y de seguridad (firewalls, IDS, IPS, etc).

5- Las equipes de mantenimiento y de operación deben estar concientizadas e entrenadas con respectos a las medidas de seguridad requeridas por el plan de seguridad

6- Los equipamientos y sistemas deben poseer certificación de seguridad.

7- Cada red debe ser poseer una topología que tenga en cuenta los aspectos de seguridad, considerando por lo menos lo siguiente:

a) Los puntos de interconexión con otras redes deben poseer activos de seguridad, como firewalls y IDS/IPS, instalados y adecuadamente configurados y monitoreados.

b) Las direcciones IP deben ser proyectadas para que non sean conocidas en la Internet.

c) Los firewall deben ser configurados, por lo menos, con las siguientes reglas:

- Política de negación (*deny all*) como default;
- Protocolos *web* (http, https, por ejemplo) solamente *outgoing;*
- Protocolos de e-mail en las dos direcciones.

d) Los enrutadores deben ser configurados considerando el uso de ACLs y NAT, así como ocultar las direcciones IP.

e) Los enrutadores deben estar constantemente actualizados, con *passwords* y *login* distintos de los de fabrica.

f) Las interconexiones de las redes con la REDDIG II deben ser hechas con redundancia de activos, incluyendo los de seguridad, y otras providencias que garantan la disponibilidad y integridad de las informaciones, así como el desempeño de la red según sus especificaciones;

g) Las conexiones con las redes publicas (internet) deben poseer topología que garanta la seguridad en múltiples camadas.

h) La gerencia de la red debe ser hecha por medio del protocolo SNMP versión 3, con la activación de alertas y de SNMP *traps*. El acceso a los dispositivos deben ser hechos con el uso de autenticación segura

i) Los links de gerenciamiento deben ser encriptados;

8- Las líneas de comunicación críticas para la interconexión de las redes de los Estados con la REDDIG II deben ser constantemente monitoreadas;

9- Hay que se tener un proceso de gestión de la configuración de las redes, con procedimientos para la actualización de versiones de software, de cambios de hardware y de puntos de conectividad, así como para la guarda de copias *backup* do *softwares* de instalación;

10- Es necesario se tener procedimientos específicos para el control de acceso físico y lógico a los equipamientos y sistemas de las redes, con el uso de claves seguras, equipos de identificación de identidad como tarjetas magnéticas, biometría, etc. Los enrutadores y otros activos de rede y de seguridad deben tener desactivados sus *logins* y *passwords* de fabrica;

11- Los equipamientos y sistemas críticos para la operación, supervisión y monitoreo de las redes deben poseer fornecimiento continuo de energía y climatización adecuada;

12- Los sistemas, aplicaciones y activos de red y seguridad deben ser configurados para ejecución solamente de los servicios realmente necesarios (*hardening*), se desactivando servicios desnecesarios a la operación como, por ejemplo, FTP, DNS, etc;

13- Es necesario que se tenga equipe de respuesta a incidentes de seguridad debidamente preparada para garantizar la ejecución de las medidas de protección necesarias;

14- Es necesario que se tenga una equipe de específica para el monitoreo del estado de los equipamientos y activos de seguridad, tales como firewalls, IDS/IPS, etc.

15- Es recomendable el uso de VPN para proveer comunicaciones que requieran confidencialidad y integridad de las informaciones. En estos casos, deben ser considerados los siguientes aspectos:

- Seguridad en el *endpoint* y en el *termination point* ;
- Protección en contra *software* maliciosos;
- Autenticación;
- Detección de intrusos con IDS/IPS;
- El uso de firewalls; y
- El uso de la técnica de split tunneling.

16- Las redes que soportan convergencia en IP, con el tráfico de voz y datos, deben considerar, por lo menos:

- Uso de QoS para la definición de las prioridades de transmisión de los datos;
- Todos los servidores VOIP deben ser configurados con protección en contra software maliciosos;
- Los dispositivos VOIP, como computadoras portando softphones, deben poseer firewalls personales activados, así como programas antivirus constantemente actualizados;

- Los servidores VOIP deben estar en una rede protegida por firewalls y IDS/IPS;
- Solamente deben estar disponibles las puertas de comunicación estrictamente necesarias para el soporte a VOIP;
- Todos los accesos a los servidores deben ser autenticados.

17- Los accesos remotos (RAS) deben ser implementados considerando, por lo menos:

- Uso de firewalls;
- Enrutadores con ACL;
- Encriptación de los links externos, especialmente los conectados a la internet;
- Autentificación fuerte
- Antivirus actualizado;
- Auditoria permanente

18- Las redes inalámbricas WLAN (*wireless*) deben ser implementadas considerando, por lo menos:

- Las interconexiones con la infraestructura de la red principal deben ser protegidas por firewalls;
- Implementar VPN para la conexión entre un cliente y un firewall de periferia;
- Los clientes (computadoras, laptops, smartphones, etc) deben tener firewalls personales y antivirus;
- El protocolo SNMP debe estar configurado para acceso solamente de lectura;
- Uso de SSH para gerencia de los links; y
- Los dispositivos de acceso a la red deben estar en locales físicamente seguros.

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APPENDIX D

AERONAUTICAL TELECOMMUNICATION NETWORK OF THE SAM REGION (REDDIG II)

ROUTING POLICY FOR THE SAM REGION

April 2013

TABLE OF CONTENTS

REFERENCES

- Doc 9855 – Guidelines on the Use of the Public Internet for Aeronautical Applications
- Doc 9896 – Manual for the Aeronautical Telecommunication Network (ATN) using IPS Standards and Protocols
- Guidance for the Implementation of National Digital Networks that Use the IP Protocol to Support Current and Future Aeronautical Applications (SAM Region)
- Air Navigation Plan for the Caribbean and South American Regions – FASID – Tables CNS1A and CNS1C
- SAM Regional IP Addressing Plan
- RFC 4271 –BGP-4 Specifications
- RFC 4360 – BGP Extended Communities Attribute
- CNS Table 1Ba – Regional Router Plan / SAM Region

GLOSSARY OF ACRONYMS

- AMHS ATS Message Handling System
- ANSP Air Navigation Service Provider
- ARIN American Registry for Internet Numbers
- ATN Aeronautical Telecommunication Network
- BER Bit Error Rate
- BGP Border Gateway Protocol
- EGP Exterior Gateway Protocol
- ES End System
- EUR/NAT European and North Atlantic Region
- FASID Facilities and Services Implementation Document
- GREPECAS Caribbean/South American Regional Planning and Implementation Group
- IANA Internet Assigned Numbers Authority
- IGP Interior Gateway Protocol
- IPS Internet Protocol Suite
- ISO International Organization for Standardization
- MPLS Multiprotocol Label Switching
- OSI Open System Interconnection
- OSPF Open Shortest Path First
- PBR Policy-Based Routing
- QoS Quality of Service
- REDDIG South American Digital Network
- RFC Request for Comments
- RIP Routing Information Protocol
- RIR Regional Internet Registry
- SAM South American Region
- SLA Service Level Agreement
- SICAS Secondary Surveillance Radar Improvements and Collision Avoidance Systems
- SICASP SICAS Panel (ICAO)
- TCP Transmission Control Protocol
- TSP Telecommunication Service Provider
- VoIP Voice Over IP
- VPN Virtual Private Network
- UDP User Datagram Protocol
- WACAF Western and Central African Region
- WAN Wide Area Network

DEFINITIONS

The following definitions are applicable for purposes of this document:

Bandwidth: maximum packet rate from a dedicated connection port, expressed in kbits/s or Mbits/s.

REDDIG II Applications: services to be provided by REDDIG II as defined in the main body of the document.

Physical Layer (Level 1): The physical layer defines the technical characteristics of the system's electrical and optical (physical) devices. It contains the cabling or other communication channels that communicate directly with the network interface controller. Accordingly, it is concerned with allowing for simple, reliable communication, in most cases with basic error control:

Layer functions:

- It moves bits (or bytes, in accordance with the transmission unit) through a transmission medium;
- It defines the electrical and mechanical characteristics of the medium, the bit transfer rate, voltages, etc.
- It executes or controls the data transmission volume and rate.

The physical layer is not responsible for dealing with issues like transmission errors, which are addressed by other layers of the OSI model.

Network Layer (Level 3): This is the network layer responsible for addressing network packets, also known as datagrams, by associating logical addresses (IP) with physical addresses, so that network packets reach their destination properly. This layer also determines the routes packets will take to reach their destination, based on elements like network traffic conditions and priorities.

This layer is used when the network has more than one segment and, as a result, a packet can take more than one path from origin to destination.

Layer functions:

- To move packets from their original source to their destination over one or more links.
- To define how network devices discover each other and how packets are routed to their final destination.

Availability: performance measurement parameter consisting of the percentage of time the PP/node (as the case may be) is operational within a specified service provision time period.

Router: equipment endowed with IP processing capacity for the purpose of determining the routes over which packets must be routed.

Inter-regional Routers: this is equipment that interconnects the routers with other ICAO Regions. In practical terms, these are routers belonging to a State AS that link up the Region with the EUR/NAT and WACAF Regions by means of the CAFSAT network, with the CAR Region via the interconnection of the MEVA II and REDDIG networks and with the APAC Region through contractual Telecommunication Service Providers (TSP).

Intra-regional Routers: for purposes of this document, these are the routers used for communication within the SAM Region.

Inter-domain routing: Data packet routing by an AS with different administrative authorities.

Intra-domain routing: Data packet routing by a single AS.

Path Vector Protocol: Protocol used for routing information interchanges among different Autonomous Systems (AS), as in the case of BGP-4. The term "path vector" bears in mind that BGP-4 routing information has a sequence of AS numbers that indicate the path taken by a given route.

Routing Protocol: that used among routers to exchange information about the network topology. It permits the updating of the routing table used by routers to choose the best path for sending a packet between network segments.

Internet Gateway Protocol (IGP): routing protocol that exchanges information within an Autonomous System (AS); for example: RIP (Routing Information Protocol) and OSPF (Open Shortest Path First).

Exterior Gateway Protocol (EGP): routing protocol that interconnects different Autonomous Systems (AS). BGP is a type of EGP.

REDDIG II Member States' Network: set of interconnected equipment, cables and software belonging to those represented by the Contracting Party.

Delay (or latency): service performance measurement parameter consisting of the average transit time of a 64-byte packet between two of the Contracting Party's PPs.

Delay: in this document, delay is understood to be an inherent characteristic of statistical and deterministic networks that consists of the end-to-end application propagation time.

Physical security of the data: for purposes of this tender, physical security is understood to mean protection against unauthorized access to the successful bidder's communication circuits and devices. Inclusion of cryptography in the communication circuits by the successful bidder is not part of this process.

Autonomous System: set of systems administered by a single administrative authority following an internal policy established by the authority. In the SAM Region, this could be a State or an Air Navigation Service Provider (ANSP). Autonomous Systems can also be called Routing Domain systems.

1. INTRODUCTION

1.1 Background

1.1.1 When referring to the Aeronautical Telecommunication Network (ATN), it is necessary to return to the year 1989, when the Secondary Surveillance Radar Improvements Panel (SICASP), at the instruction of the Special Committee on Future Air Navigation Systems (FANS), started developing documents for voice and data interchanges via different digital communication platforms.

1.1.2 To ensure the success of the SICASP's endeavours, the FANS Committee recommended adoption of open protocol principles--International Organization for Standardization's (ISO) Open Systems Interconnection (OSI)--, so as to provide for the interoperability of existing network platforms.

1.1.3 It is important to stress that many ICAO provisions were developed, insofar as air-ground and ground-ground applications are concerned, based on the OSI platform. Furthermore, although ICAO Member States gave significant support to the use of the OSI topology, the industry promoted equipment based on the Internet Protocol Suite (IPS) platform.

1.1.4 The International Civil Aviation Organization (ICAO) Air Navigation Committee (ANC) created the Aeronautical Communications Panel (ACP) in 2003 by combining the Aeronautical Mobile Communications Panel (AMCP) and the Aeronautical Telecommunication Network Panel (ATNP).

1.1.5 One of the main recommendations made, from the very beginning of the Panel's activities, was that ICAO should concern itself with developing ATN documentation based on TCP/IP protocols.

1.1.6 The ACP Working Group I (IP) (WG-I) was set up to effectively support development of the new provisions. Among its functions are security matters and the convergence and adaptation of ATN/OSI provisions for ATN/IP. It also deals with the development of documents for new applications directly based on ATN/IP.

1.1.7 The Caribbean/South American Regional Planning and Implementation Group (GREPECAS), through the former CNS/ATM Subgroup, already had the ATN Task Force (ATN/TF) operating to develop guidance material based on TCP/IP protocols for the CAR/SAM States.

1.1.8 One of the ATN/TF deliverables was the preparation of an addressing system based on version 4 of the IP protocol (IPv4) for all CAR/SAM States; it is currently under implementation in those Regions, as reflected in **Appendix A** to this document, insofar as the SAM States are concerned.

1.1.9 The CAR/SAM addressing plan was presented at the First Meeting of the ACP Working Group of the Whole, held in September 2008. Emphasis was placed on the fact that the ultimate purpose was to implement IPv6, but that IPv4 would be used as a way to further implementation of ATN applications in the CAR and SAM Regions, especially of the ATS Message Handling System (AMHS).

1.1.10 It should be stressed that the provisions being developed by ICAO Headquarters in Montreal are based on IPv6. Nevertheless, ICAO itself is seeking ways to make the acquisition of address blocks viable for use in all Regions.

1.1.11 It is also noted that the routers implemented in the SAM States that need to exchange data with other Regions are dual stack, meaning that they can handle IPv4 or IPv6 packets.

1.1.12 Once ICAO and the Internet Assigned Numbers Authority (IANA), responsible for worldwide provision of addresses, and its regional offices, called Regional Internet Registry (RIR) are able to obtain IP addressing blocks, the conditions will be favourable for implementation of the new IP addressing system for the SAM Region through a transition plan to be developed in due time.

1.2 **Document Organization**

1.2.1 The initial part of this document consists of References, the Glossary of Acronyms and Definitions that serve as a guide to the entire document, in view of the large amount of information this policy encompasses. Section 1.1 of the Background, in Chapter 1, supplements this segment with a historical account of ICAO activities to promote ATN/IPS use in communication networks.

1.2.2 Chapter 2 contains a general description of the SAM Regional IPv4 addressing plan, developed as a transitional phase toward the future implementation of the IPv6 addressing system.

1.2.3 Considering that the core IP structure links up a series of Autonomous Systems (AS) of different States and other Regions, Chapter 3 sets out the main concepts of the Border Gateway Protocol (BGP) in the version being currently implemented (BGP-4).

1.2.4 To conclude, Chapter 4 covers the use of BGP-4 routing as specifically applied to the South American Region and its interconnection with other ICAO Regions.

2. THE SAM ATN

2.1 SAM IPv4 Addressing Plan

2.1.1 With a view to the adoption of the IP addressing plan, the ATN/TF of the former CNS/ATM conducted a study contemplating the application of IPv4 in all ICAO Regions. Accordingly, an analysis was conducted of the number of States/Territories per Region, the number of addresses that each State/Territory could use and the number of addresses reserved for the interconnection of States/Territories.

2.1.2 It should be noted, first, that in order for the networks assigned to each State/Territory to be private networks (RFC 1918), the first of the four bytes that make up the assigned addresses will always have a decimal value equal to 10. The three other bytes will be used to hierarchically distribute the address blocks corresponding to each State.

2.1.3 The conclusions of that study were that:

a) The first four bits of the second byte (4 bits) would be used to identify the Regions into which the world's States/Territories are grouped:
- SAM: South American Office.
- NACC: North American, Central American and Caribbean Office.
- APAC: Asia and Pacific Office.
- MID: Middle East Office.
- WACAF: Western and Central African Office.
- ESAF: Eastern and Southern African Office.
- EUR/NAT: European and North Atlantic Office.

b) Seven bits would be used at the State/Territorial level. This means that it is possible to have up to 128 States per Region. To give a real example, even the most numerous region, EUR/NAT, has only 53 States/Territories; this would leave many numbers vacant.

c) The last five bits of the third byte, and the eight bits comprising the fourth byte (13 bits), would be reserved for the hosts. This would make it possible to address 8,190 hosts per State/Territory. It should be noted that this figure was considered because of current requirements and possible future applications to be implemented, mainly in the more developed States.

2.1.4 In the light of the foregoing, the scheme adopted has the format set out in Table 1:

IPv4 Address						
10		Region / State/Territory		State/Territory / Host		Host
0 0 0 0 1 0 1 0	.	0 0 0 0 0 0 0 0	.	0 0 0 0 0 0 0 0	.	0 0 0 0 0 0 0 1
1st Byte	.	2nd Byte	.	3rd Byte	.	4th Byte

Table 1: IPv4 Addressing Scheme

2.1.5 In summary, the proposed assignment scheme could cover:

a) 16 Regions.

b) 128 States/Territories per Region.
c) 8,190 hosts per State/Territory.

2.1.6 The corresponding addresses have been assigned to each SAM State/Territory, bearing in mind the contents of the table attached as Appendix A. In said table, the last available network is labeled “RESERVED,” so that it can be used for inter- and intra-regional links.

2.1.7 Although planned for possible application in all Regions, the IP addressing plan was only adopted and is being used massively by the SAM Region, while ICAO and IANA are working to obtain IPv6 addressing blocks for all Regions.

2.1.8 REDDIG is the communication platform used in South America. It links up State routers for transmission of IP applications based on the addressing plan that has been developed. The characteristics of the existing REDDIG and the data for modernizing its infrastructure are to be found in **Appendix C**.

.

3. THE BASICS OF ROUTING BY DOMAIN

3.1 BGP Protocol

3.1.1 The BGP protocol, in its most recent version (4), is a path vector protocol used for the exchange of routing information between different autonomous systems.

3.1.2 The main features of BGP-4 are:

a) Origin: reports the origin of the BGP-4 route. If generated by an Internet gateway protocol (IGP), the metric is so announced in the BGP route (the router always chooses the path with the lowest metric generated by the IGP).
b) AS-Path: indicates the ASs traversed by the route. The BGP-4 databank keeps all path alternatives, but chooses the one that traverses the smallest number of ASs.
c) Next-hop: indicates the interface of the originating router where the BGP-4 route was announced. All BGP-4 routers will route the route data if there is connectivity with the IP address described in the NEXT-HOP attribute.
d) Local-preference: this attribute has a local significance and ensures that BGP-4 selects the best exit path based on the available WAN links.
e) Multi-exit-discriminator: defines the path along which neighbouring BGP-4 routers will send packets addressed to their internal networks.

3.1.3 Unlike other interior routing protocols that use the User Datagram Protocol (UDP), BGP-4 employs the Transmission Control Protocol (TCP) as its transport protocol. This means that the circuit is connection-oriented and guarantees reliable packet delivery. As a result, BGP-4 has no need for relay mechanisms, inasmuch as the TCP fulfills that function.

3.1.4 In order for BGP-4 to establish router adjacency, the neighbourhood must be explicitly configured. In that way, relationships are formed among routers configured as neighbours, with the result that the exchange of keepalive messages at regular time intervals reveals the conditions of each.

3.1.5 Once the adjacencies have been established, routers send neighbours the BGP-4 routes in their routing tables, so that those neighbours will be able to successfully establish the referred adjacencies. Each router adds to its BGP-4 topology databases all routes learned from neighbours.

3.1.6 The BGP protocol was originally used for routing between different ASs. Nonetheless, it can be used in routers belonging to the same AS and in that case is known as IBGP. Figure 4 illustrates the case in which routers B, C and D of AS 65000 are considered IBGP neighbours.

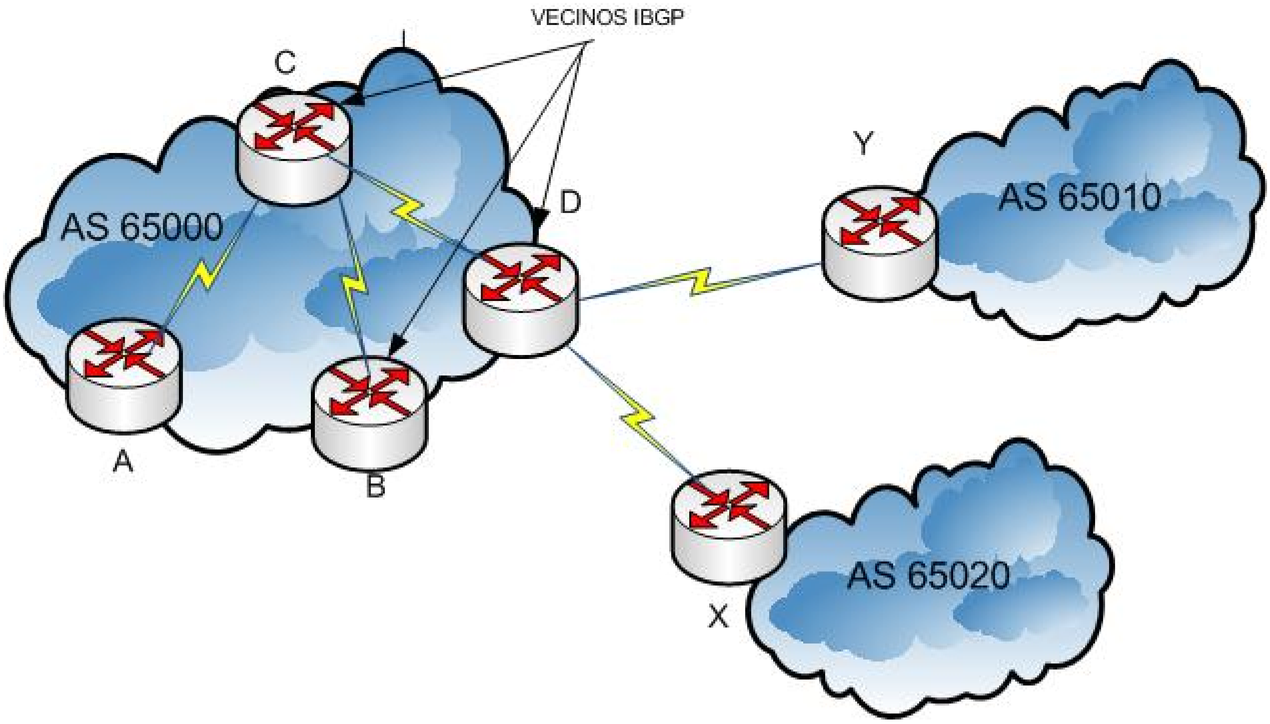

Figure 4: Internal BGP Neighbouring Routers

3.1.7 Figure 5 shows the neighbourhood between routers belonging to ASs with different administrative domains. In this case, D and Y are exterior neighbours and the same thing holds true with routers B and X.

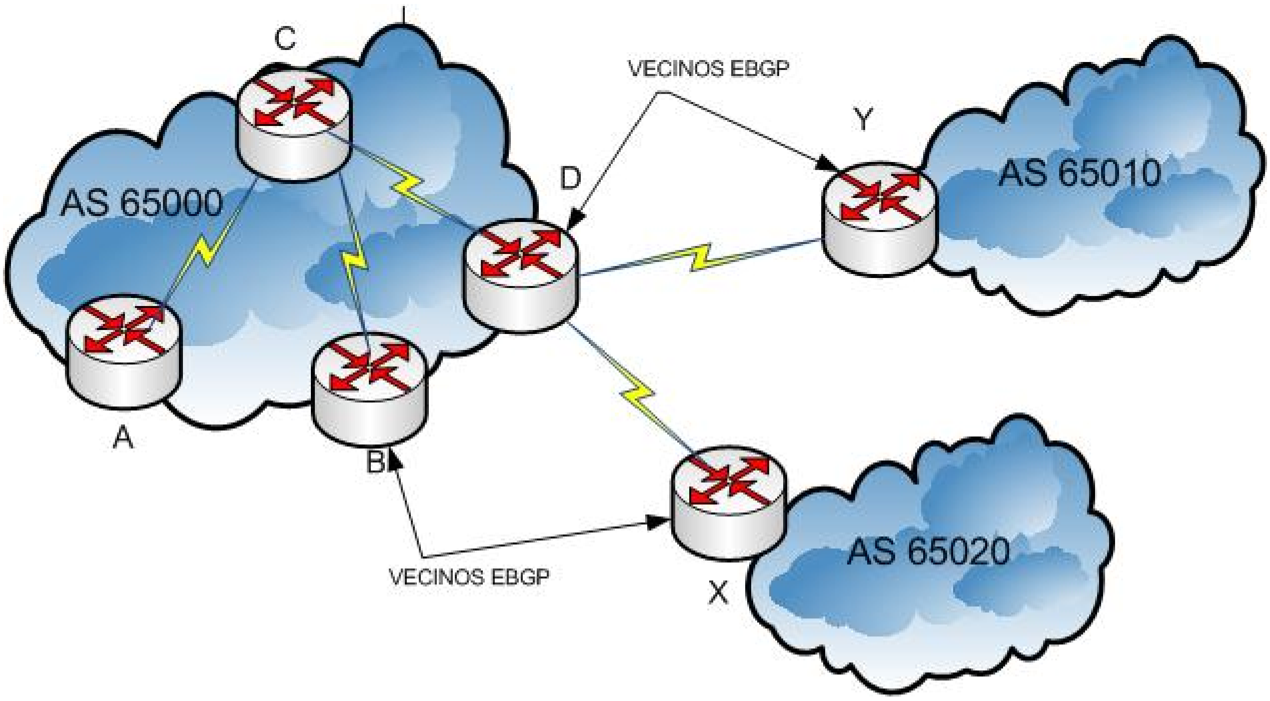

Figure 5: Exterior BGP Neighbouring Routers

3.2 **BGP Autonomous Systems**

3.2.1 As previously defined, an Autonomous System represents a collection of networks and their routers under a single administration. That said, the main objective of BGP-4 is to guarantee the interchange of routing information between different ASs.

3.2.2 Autonomous systems can use more than one IGP, resulting in a series of different metrics associated with each of the interior protocols in the BGP-4 AS exit router. Nonetheless, the most important characteristic of the AS is that, to other BGP-4 routers, there would seem to be only one IGP within the AS and external routers will easily know how to reach the connected internal destinations.

3.2.3 The Internet Assigned Numbers Authority (IANA) is the organization responsible for allocating AS numbers. The American Registry for Internet Numbers (ARIN) is the IANA Regional Office (RIR Regional Internet Registry) that performs that task specifically in the Americas. AS numbers range from 1 to 65535, with those in the range of 64512 to 65535 being reserved for private use.

3.3 **BGP-4 Routing**

3.3.1 An interior routing protocol seeks the fastest path between one point on a corporate system and another, based on metrics.

3.3.2 BGP-4, which is an exterior routing protocol, uses a different mechanism from that employed by IGPs. BGP is a policy-based routing protocol (PBR) that allows for traffic flow control over the network by using, *inter alia*, the attributes defined in 3.1. This enables the network administration to handle preferential paths.

3.3.3 BGP-4 is known as a path vector, for it takes into account that BGP-4 routing information has a sequence of AS numbers, indicating the path crossed by a given route and the routers announce the hop-by-hop path to the destination AS. Figure 6 contains a simple example of BGP routing.

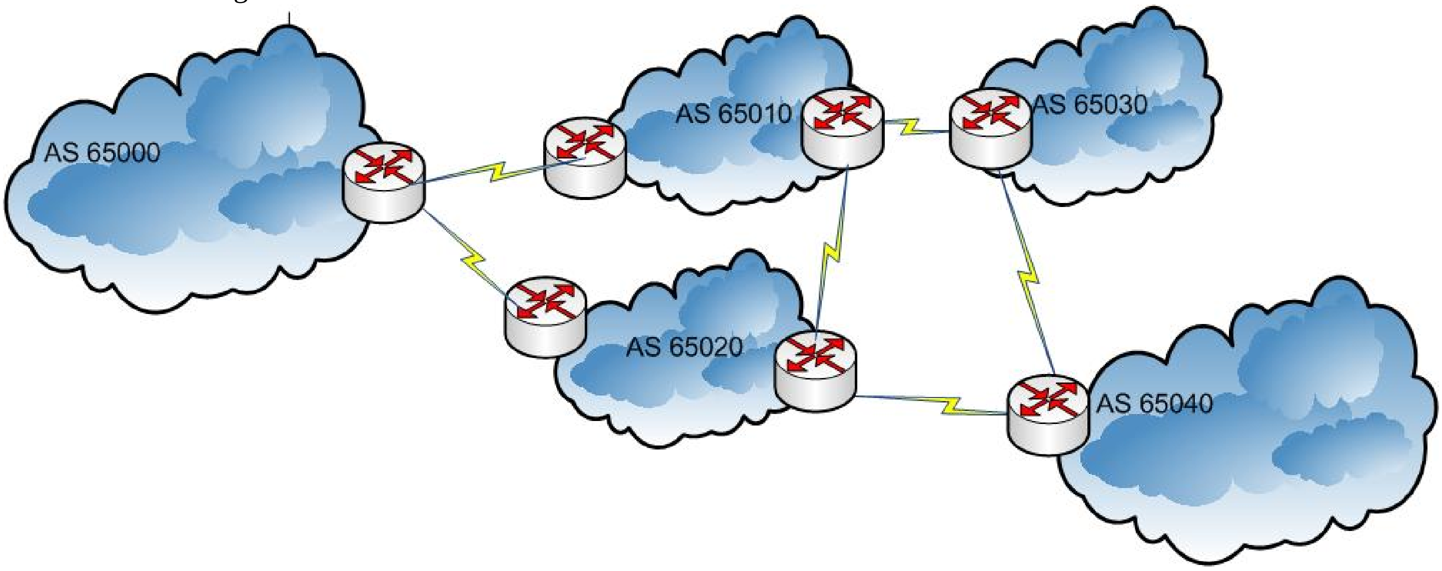

Figure 6: Routing between different ASs

3.3.4 According to Figure 6, it may be concluded that the following paths can be taken for AS 65000 to reach AS 65040 networks:

a) 65020-65040;

b) 65010-65030-65040;
c) 65010-65020-65040;
d) 65020-65010-65030-65040.

3.3.5 BGP-4 routers choose the path neighbours should use to send their packets. Accordingly, the most that AS 65000, which is the origin, can do is to decide which AS to traverse in its exit.

3.3.6 By way of example, if the AS 65000 exit router chooses to reach 65040 via AS 65020, the path to be taken from AS 65020 onward is internally chosen by the latter. In the given example, AS 65020 informs AS 65000 that the path to reach AS 65040 is 65020-65040, even if there is another path available, which, however, AS 65020 does not disclose to AS 65000, unless there is a problem with the main path.

4. ROUTINGS THROUGH SAM DOMAINS

4.1 Routing Domains

4.1.1 Private AS numbers, defined in Doc 9896 and described in **Appendix F**, are recommended for use in the SAM Region as a means for utilizing the BGP-4 routing protocol and safely guaranteeing the isolation of autonomous systems.

Note: The BGP-4 protocol makes it possible to adopt a series of optional and extension parameters. It is accordingly recommended that use of those attributes be defined in the future, in order to make the most of the protocol resources. As BGP-4 was originally developed for IPv4 use, however, its initial application will create no major problems.

4.1.2 From an administrative point of view, the SAM ATN/IPS consists of a series of administrative domains that can be represented, in the SAM Region, by a State or by a State's Air Navigation Service Provider (ANSP).

4.1.3 In terms of technical routing concepts, the interconnection of administrative domains rests on the exchange of information between different autonomous systems, each with a series of IP addresses. SAM ASs are interconnected by means of the REDDIG platform and, in the future, will be by REDDIG II.

4.1.4 Appendix C shows the basic characteristics of the existing REDDIG platform, as well as those of the future REDDIG II. The aforementioned architecture supports the existing and future services that are or will be instituted in the SAM Region. **Appendix D** describes the applications that should be transmitted via the cited communication network.

4.2 Domain Routing in the SAM Region

4.2.1 Appendix A shows the assignment of IP address ranges to be followed by the Aeronautical Authorities of each State in the Region in the national routers that link up with REDDIG. It represents the SAM Region's existing IP addressing plan.

4.2.2 As mentioned earlier, when ICAO, acting in favour of the States, together with IANA, acquires the IPv6 address blocks, it will be necessary to prepare a new SAM IP addressing plan. Furthermore, the routers used in the SAM Region are dual stack with regard to the possibility of routing inter-regional packets in which the destination is already using IPv6. Figure 7 illustrates that possibility for AMHS application.

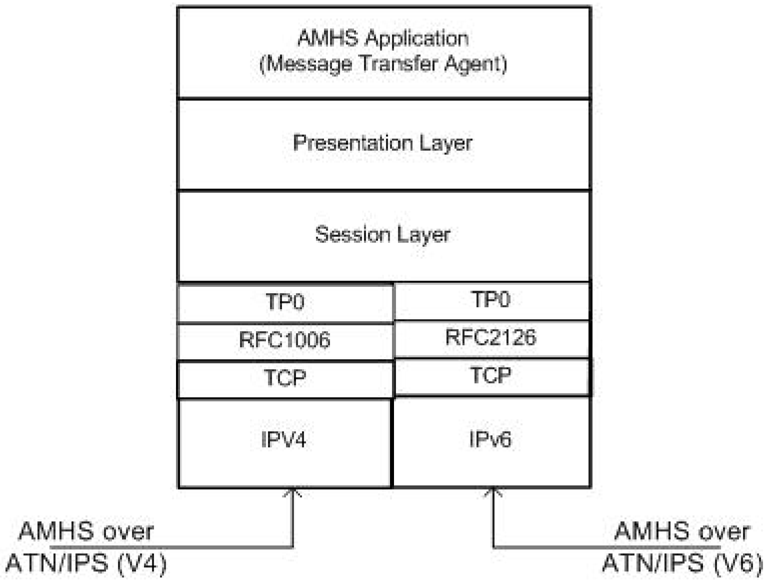

Figure 7: Translation of IPV4/IPv6 Addresses

4.2.3 The REDDIG, it is known, is used to link up the ASs of different States in such a way that one end system (ES) can reach another in a different State. Intra-regional routers are used for that purpose, as shown in Figure 8.

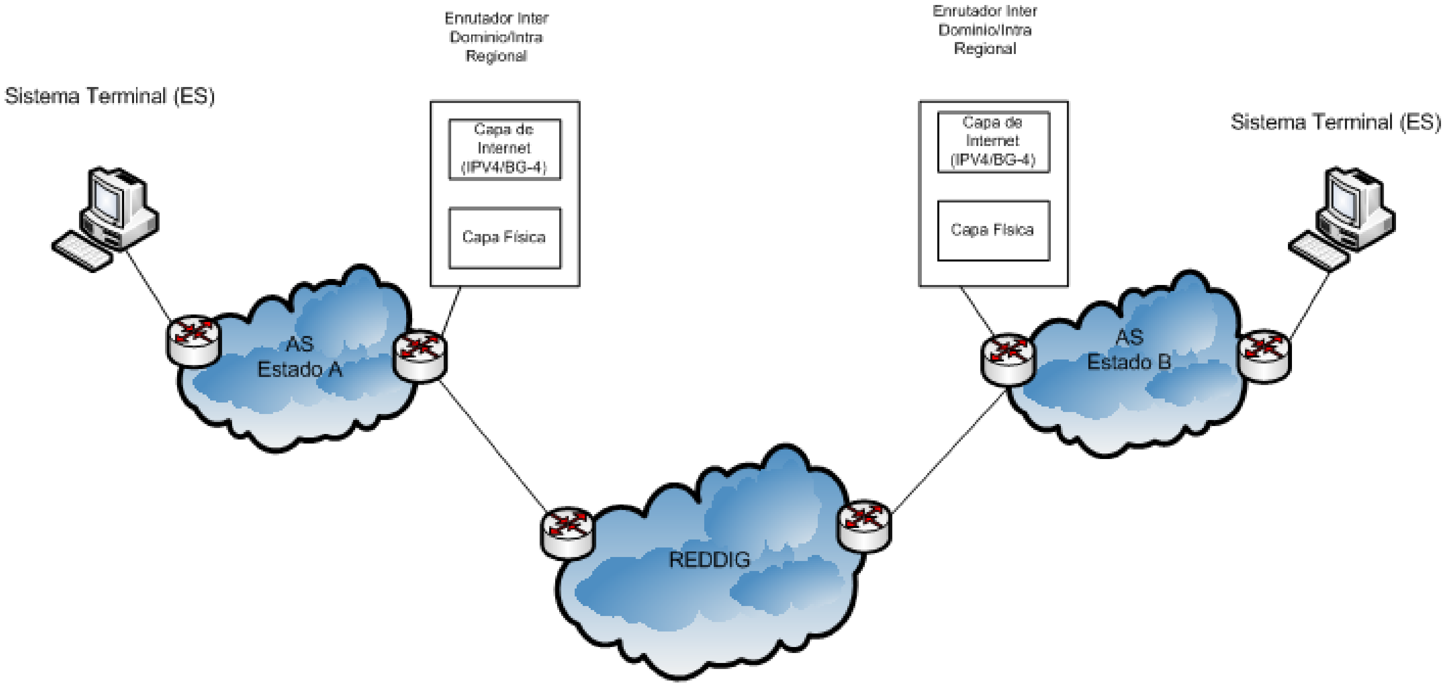

Figure 8: SAM Intra-Regional Routing

4.2.4 Figure 9 presents the basic routing topology for the SAM Region based on the requirements present in the FASID and in the Table, together with the future requirements as presented in Appendix D. Inasmuch as REDDIG II is a core IP network, the services will be transmitted from origin to destination seamlessly, using end system IP addresses and numbers of the ASs involved.

4.2.5 With the use of BGP-4, the concepts presented in Section 3.3, Routing with BGP-4, will logically have to be considered, inasmuch as it is not the origin router that chooses the path to the destination, but the router (Next hop).

4.2.6 Consequently, Figure 9 reflects the following SAM Region routings, bearing in mind the origin and destination of the applications, shown in different colors, as well as CNS Table IBa (Regional Router Plan) that appears in **Appendix E**.

a) In purple: intra-regional links using inter-domain routers (AS) of the States linked up by REDDIG;
b) In red: inter-regional links using the MEVA II/REDDIG interconnection; and
c) In black: inter-regional links in which the routers belonging to a SAM AS reach their destination via a PST or through interconnection with the CAFSAT network.

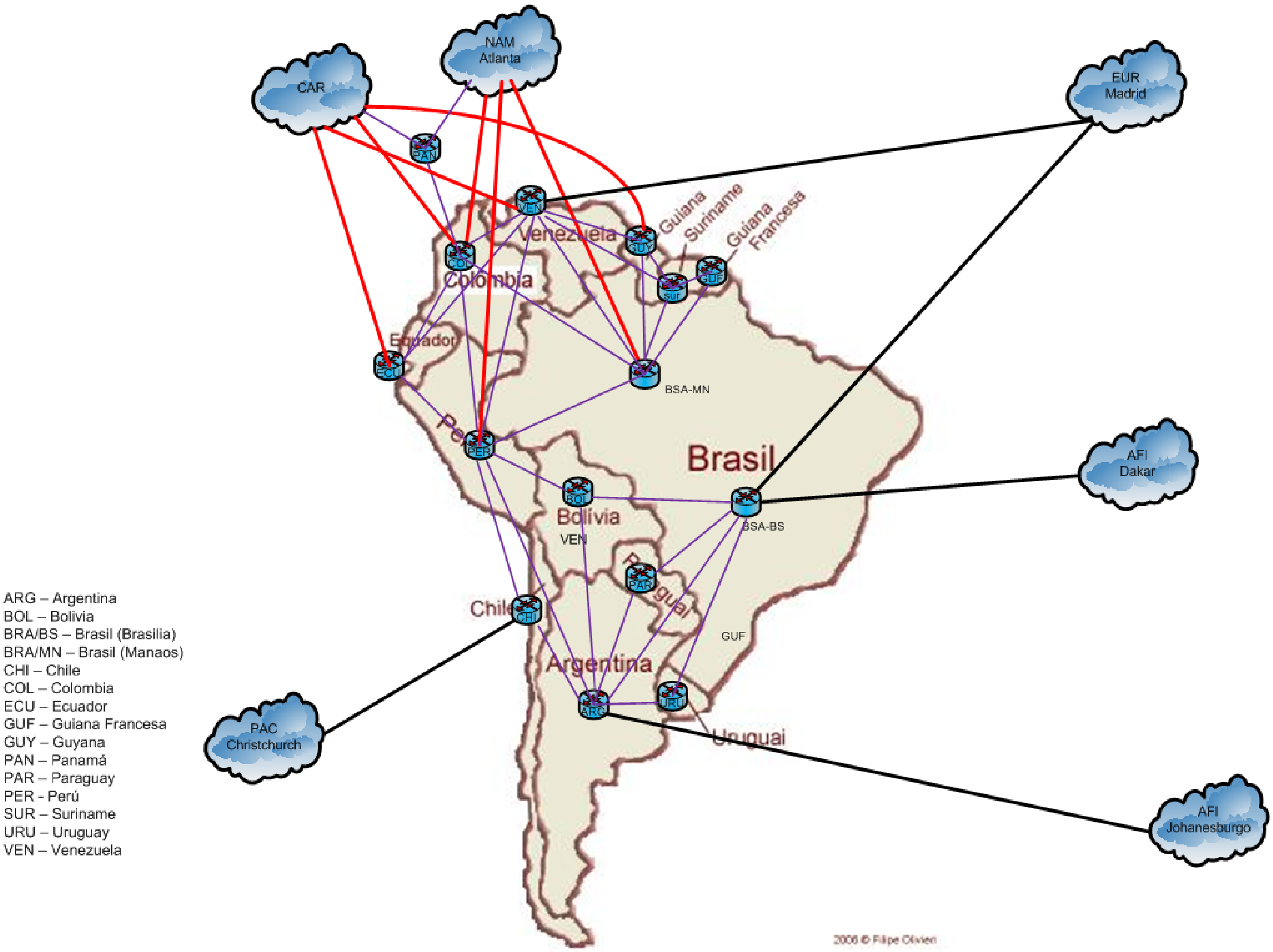

Figure 9: Basic SAM Routing Topology

4.2.7 The following BGP-4 routing policies should be observed in the SAM Region:

a) If a router has several possible paths to reach its destination, it should choose the one crossing the fewest ASs.

   Note: REDDIG employs the satellite network, which operates as a deterministic network with a single hop. In the future, REDDIG II will use the satellite network as its main network, but the ground network, supplied by a PST, will have an infrastructure that could involve several different ASs.

b) All routers in the SAM Region (REDDIG and States) that are configured using the BGP-4 protocol shall do their authentication with their configured neighbours.
c) In order to reduce the size of routing tables, SAM BGP-4 routers should be configured to accept route aggregation.
d) BGP-4 routers belonging to an administrative domain should be configured to receive the aggregation of all internal AS routes.
e) The Local-Preference attribute should be configured in such a way that the BGP-4 router will choose the best exit path when the router is connected to more than one WAN.

4.2.8 In addition to the aforementioned policies, each State or ANSP has its own policies that will supplement those covered in this document.

APPENDIX A

ASSIGNMENT OF NETWORKS BY STATE/TERRITORY

Asignación de Redes por Estado/Territorio.

Región	Nro	Estado / Territorio	Red	Direcciones utilizables	Notacion Decimal	Notacion Binaria	Región	Estado / Territorio	Host's
SAM	1	Argentina	10.0.0.0 / 19	Primera	10 . 0 . 0 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 0 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 0 . 31 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 0 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	2	Chile	10.0.32.0 / 19	Primera	10 . 0 . 32 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 0 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 0 . 63 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 0 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	3	Brasil	10.0.64.0 / 19	Primera	10 . 0 . 64 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 0 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 0 . 95 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 0 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	4	Uruguay	10.0.96.0 / 19	Primera	10 . 0 . 96 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 0 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 0 . 127 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 0 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	5	Paraguay	10.0.128.0 / 19	Primera	10 . 0 . 128 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 1 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 0 . 159 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 1 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	6	Bolivia	10.0.160.0 / 19	Primera	10 . 0 . 160 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 1 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 0 . 191 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 1 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	7	Peru	10.0.192.0 / 19	Primera	10 . 0 . 192 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 1 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 0 . 223 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 1 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	8	Ecuador	10.0.224.0 / 19	Primera	10 . 0 . 224 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 1 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 0 . 255 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 1 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	9	Colombia	10.1.0.0 / 19	Primera	10 . 1 . 0 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 0 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 1 . 31 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 0 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	10	Venezuela	10.1.32.0 / 19	Primera	10 . 1 . 32 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 0 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 1 . 63 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 0 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	11	Guyana	10.1.64.0 / 19	Primera	10 . 1 . 64 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 0 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 1 . 95 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 0 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0

Asignación de Redes por Estado/Territorio.

Región	Nro	Estado / Territorio	Red	Direcciones utilizables	Notacion Decimal	Notacion Binaria			
							Región	Estado / Territorio	Host's
	12	Surinam	10.1.96.0 / 19	Primera	10 . 1 . 96 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 0 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 1 . 127 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 0 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	13	Guyana Francesa (France)	10.1.128.0 / 19	Primera	10 . 1 . 128 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 1 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 1 . 159 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 1 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	-	VACANTE	10.1.160.0 / 19	Primera	10 . 1 . 160 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 1 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 1 . 191 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 1 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	-	VACANTE	10.1.192.0 / 19	Primera	10 . 1 . 192 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 1 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 1 . 223 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 1 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	-	VACANTE	10.1.224.0 / 19	Primera	10 . 1 . 224 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 1 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 1 . 255 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 1 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
SAM	-	VACANTE	10.2.0.0 / 19	Primera	10 . 2 . 0 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 1 0 . 0 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 2 . 31 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 1 0 . 0 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	-	-	-	-	-			-	
				-	-			-	
				-	-			-	
				-	-			-	
	-	-	-	-	-			-	
				-	-			-	
				-	-			-	
				-	-			-	
	-		-	-	-			-	
				-	-			-	
				-	-			-	
				-	-			-	
	-	-	-	-	-			-	
				-	-			-	
				-	-			-	
				-	-			-	
	128 (ULTIMA)	RESERVADA	10.15.224.0 / 19	Primera	10 . 15 . 224 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	1 1 1 1 . 1 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 15 . 255 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	1 1 1 1 . 1 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0

APPENDIX B

INTER/INTRA REGIONAL LINKS

Red	Enlace				
	Nro.	Subred	Extremos	Direcciones a utilizar	
10.15.224.0 / 19	1	10.15.224.0 / 30	Argentina-Bolivia	-	10 . 15 . 224 . 0 / 30
				Argentina	10 . 15 . 224 . 1 / 30
				Bolivia	10 . 15 . 224 . 2 / 30
				-	10 . 15 . 224 . 3 / 30
	2	10.15.224.4 / 30	Argentina-Chile	-	10 . 15 . 224 . 4 / 30
				Argentina	10 . 15 . 224 . 5 / 30
				Chile	10 . 15 . 224 . 6 / 30
				-	10 . 15 . 224 . 7 / 30
	3	10.15.224.8 / 30	Argentina-Paraguay	-	10 . 15 . 224 . 8 / 30
				Argentina	10 . 15 . 224 . 9 / 30
				Paraguay	10 . 15 . 224 . 10 / 30
				-	10 . 15 . 224 . 11 / 30
	4	10.15.224.12 / 30	Argentina-Peru	-	10 . 15 . 224 . 12 / 30
				Argentina	10 . 15 . 224 . 13 / 30
				Peru	10 . 15 . 224 . 14 / 30
				-	10 . 15 . 224 . 15 / 30
	5	10.15.224.16 / 30	Argentina-Uruguay	-	10 . 15 . 224 . 16 / 30
				Argentina	10 . 15 . 224 . 17 / 30
				Uruguay	10 . 15 . 224 . 18 / 30
				-	10 . 15 . 224 . 19 / 30
	6	10.15.224.20 / 30	Argentina-AFI	-	10 . 15 . 224 . 20 / 30
				Argentina	10 . 15 . 224 . 21 / 30
				AFI (Johannesburgo)	10 . 15 . 224 . 22 / 30
				-	10 . 15 . 224 . 23 / 30
	7	10.15.224.24 / 30	Brasil-Colombia	-	10 . 15 . 224 . 24 / 30
				Brasil	10 . 15 . 224 . 25 / 30
				Colombia	10 . 15 . 224 . 26 / 30
				-	10 . 15 . 224 . 27 / 30
	8	10.15.224.28 / 30	Brasil-Guyana	-	10 . 15 . 224 . 28 / 30
				Brasil	10 . 15 . 224 . 29 / 30
				Guyana	10 . 15 . 224 . 30 / 30
				-	10 . 15 . 224 . 31 / 30
	9	10.15.224.32 / 30	Brasil-Guyana Francesa	-	10 . 15 . 224 . 32 / 30
				Brasil	10 . 15 . 224 . 33 / 30
				Guyana Francesa	10 . 15 . 224 . 34 / 30
				-	10 . 15 . 224 . 35 / 30

Enlaces Inter/Intra Regionales correspondientes a la Región SAM

Red	Enlace				
	Nro.	Subred	Extremos	Direcciones a utilizar	
10.15.224.0 / 19	10	10.15.224.36 / 30	Brasil-Peru	-	10 . 15 . 224 . 36 / 30
				Brasil	10 . 15 . 224 . 37 / 30
				Peru	10 . 15 . 224 . 38 / 30
				-	10 . 15 . 224 . 39 / 30
	11	10.15.224.40 / 30	Brasil-Surinam	-	10 . 15 . 224 . 40 / 30
				Brasil	10 . 15 . 224 . 41 / 30
				Surinam	10 . 15 . 224 . 42 / 30
				-	10 . 15 . 224 . 43 / 30
	12	10.15.224.44 / 30	Brasil-Venezuela	-	10 . 15 . 224 . 44 / 30
				Brasil	10 . 15 . 224 . 45 / 30
				Venezuela	10 . 15 . 224 . 46 / 30
				-	10 . 15 . 224 . 47 / 30
	13	10.15.224.48 / 30	Brasil-AFI (tentativo)	-	10 . 15 . 224 . 48 / 30
				Brasil	10 . 15 . 224 . 49 / 30
				AFI (Dakar)	10 . 15 . 224 . 50 / 30
				-	10 . 15 . 224 . 51 / 30
	14	10.15.224.52 / 30	Brasil-EUR (tentativo)	-	10 . 15 . 224 . 52 / 30
				Brasil	10 . 15 . 224 . 53 / 30
				EUR (Madrid)	10 . 15 . 224 . 54 / 30
				-	10 . 15 . 224 . 55 / 30
	15	10.15.224.56 / 30	Brasil-NAM	-	10 . 15 . 224 . 56 / 30
				Brasil	10 . 15 . 224 . 57 / 30
				NAM(Atlanta)	10 . 15 . 224 . 58 / 30
				-	10 . 15 . 224 . 59 / 30
	16	10.15.224.60 / 30	Brasil-Argentina	-	10 . 15 . 224 . 60 / 30
				Brasil	10 . 15 . 224 . 61 / 30
				Argentina	10 . 15 . 224 . 62 / 30
				-	10 . 15 . 224 . 63 / 30
	17	10.15.224.64 / 30	Brasil-Bolivia	-	10 . 15 . 224 . 64 / 30
				Brasil	10 . 15 . 224 . 65 / 30
				Bolivia	10 . 15 . 224 . 66 / 30
				-	10 . 15 . 224 . 67 / 30
	18	10.15.224.68 / 30	Brasil-Paraguay	-	10 . 15 . 224 . 68 / 30
				Brasil	10 . 15 . 224 . 69 / 30
				Paraguay	10 . 15 . 224 . 70 / 30
				-	10 . 15 . 224 . 71 / 30

Enlaces Inter/Intra Regionales correspondientes a la Región SAM

Red	Enlace				
	Nro.	Subred	Extremos	Direcciones a utilizar	
10.15.224.0 / 19	19	10.15.224.72 / 30	Brasil-Uruguay	-	10 . 15 . 224 . 72 / 30
				Brasil	10 . 15 . 224 . 73 / 30
				Uruguay	10 . 15 . 224 . 74 / 30
				-	10 . 15 . 224 . 75 / 30
	20	10.15.224.76 / 30	Chile-PAC	-	10 . 15 . 224 . 76 / 30
				Chile	10 . 15 . 224 . 77 / 30
				PAC(Christchurch)	10 . 15 . 224 . 78 / 30
				-	10 . 15 . 224 . 79 / 30
	21	10.15.224.80 / 30	Chile-Peru	-	10 . 15 . 224 . 80 / 30
				Chile	10 . 15 . 224 . 81 / 30
				Peru	10 . 15 . 224 . 82 / 30
				-	10 . 15 . 224 . 83 / 30
	22	10.15.224.84 / 30	Colombia-NAM	-	10 . 15 . 224 . 84 / 30
				Colombia	10 . 15 . 224 . 85 / 30
				NAM (Atlanta)	10 . 15 . 224 . 86 / 30
				-	10 . 15 . 224 . 87 / 30
	23	10.15.224.88 / 30	Colombia-Ecuador	-	10 . 15 . 224 . 88 / 30
				Colombia	10 . 15 . 224 . 89 / 30
				Ecuador	10 . 15 . 224 . 90 / 30
				-	10 . 15 . 224 . 91 / 30
	24	10.15.224.92 / 30	Colombia-Peru	-	10 . 15 . 224 . 92 / 30
				Colombia	10 . 15 . 224 . 93 / 30
				Peru	10 . 15 . 224 . 94 / 30
				-	10 . 15 . 224 . 95 / 30
	25	10.15.224.96 / 30	Colombia-Venezuela	-	10 . 15 . 224 . 96 / 30
				Colombia	10 . 15 . 224 . 97 / 30
				Venezuela	10 . 15 . 224 . 98 / 30
				-	10 . 15 . 224 . 99 / 30
	26	10.15.224.100 / 30	Ecuador-Peru	-	10 . 15 . 224 . 100 / 30
				Ecuador	10 . 15 . 224 . 101 / 30
				Peru	10 . 15 . 224 . 102 / 30
				-	10 . 15 . 224 . 103 / 30
	27	10.15.224.104 / 30	Ecuador-Venezuela	-	10 . 15 . 224 . 104 / 30
				Ecuador	10 . 15 . 224 . 105 / 30
				Venezuela	10 . 15 . 224 . 106 / 30
				-	10 . 15 . 224 . 107 / 30

Enlaces Inter/Intra Regionales correspondientes a la Región SAM

Red	Enlace				
	Nro.	Subred	Extremos	Direcciones a utilizar	
10.15.224.0 / 19	28	10.15.224.108 / 30	Guyana Francesa-Surinam	-	10 . 15 . 224 . 108 / 30
				Guyana Francesa	10 . 15 . 224 . 109 / 30
				Surinam	10 . 15 . 224 . 110 / 30
				-	10 . 15 . 224 . 111 / 30
	29	10.15.224.112 / 30	Guyana-C-CAR	-	10 . 15 . 224 . 112 / 30
				Guyana	10 . 15 . 224 . 113 / 30
				C-CAR (Piarco)	10 . 15 . 224 . 114 / 30
				-	10 . 15 . 224 . 115 / 30
	30	10.15.224.116 / 30	Guyana-Surinam	-	10 . 15 . 224 . 116 / 30
				Guyana	10 . 15 . 224 . 117 / 30
				Surinam	10 . 15 . 224 . 118 / 30
				-	10 . 15 . 224 . 119 / 30
	31	10.15.224.120 /30	Guyana-Venezuela	-	10 . 15 . 224 . 120 / 30
				Guyana	10 . 15 . 224 . 121 / 30
				Venezuela	10 . 15 . 224 . 122 / 30
				-	10 . 15 . 224 . 123 / 30
	32	10.15.224.124 / 30	Peru-NAM	-	10 . 15 . 224 . 124 / 30
				Peru	10 . 15 . 224 . 125 / 30
				NAM (Atlanta)	10 . 15 . 224 . 126 / 30
				-	10 . 15 . 224 . 127 / 30
	33	10.15.224.128 / 30	Peru-Bolivia	-	10 . 15 . 224 . 128 / 30
				Peru	10 . 15 . 224 . 129 / 30
				Bolivia	10 . 15 . 224 . 130 / 30
				-	10 . 15 . 224 . 131 / 30
	34	10.15.224.132 / 30	Peru-Colombia	-	10 . 15 . 224 . 132 / 30
				Peru	10 . 15 . 224 . 133 / 30
				Colombia	10 . 15 . 224 . 134 / 30
				-	10 . 15 . 224 . 135 / 30
	35	10.15.224.136 / 30	Peru-Venezuela	-	10 . 15 . 224 . 136 / 30
				Peru	10 . 15 . 224 . 137 / 30
				Venezuela	10 . 15 . 224 . 138 / 30
				-	10 . 15 . 224 . 139 / 30
	36	10.15.224.140 / 30	Surinam-Venezuela	-	10 . 15 . 224 . 140 / 30
				Surinam	10 . 15 . 224 . 141 / 30
				Venezuela	10 . 15 . 224 . 142 / 30
				-	10 . 15 . 224 . 143 / 30

Enlaces Inter/Intra Regionales correspondientes a la Región SAM

Red	Enlace				
	Nro.	Subred	Extremos	Direcciones a utilizar	
10.15.224.0 / 19	37	10.15.224.144 / 30	Venezuela-CAM	-	10 . 15 . 224 . 144 / 30
				Venezuela	10 . 15 . 224 . 145 / 30
				CAM (San Juan)	10 . 15 . 224 . 146 / 30
				-	10 . 15 . 224 . 147 / 30
	38	10.15.224.148 / 30	Venezuela-EUR	-	10 . 15 . 224 . 148 / 30
				Venezuela	10 . 15 . 224 . 149 / 30
				EUR (Madrid)	10 . 15 . 224 . 150 / 30
				-	10 . 15 . 224 . 151 / 30
	39	10.15.224.152 / 30	Venezuela-Trinidad y Tobago	-	10 . 15 . 224 . 152 / 30
				Venezuela	10 . 15 . 224 . 153 / 30
				Trinidad y Tobago	10 . 15 . 224 . 154 / 30
				-	10 . 15 . 224 . 155 / 30
	40	10.15.224.156 / 30	VACANTE	-	10 . 15 . 224 . 156 / 30
					10 . 15 . 224 . 157 / 30
					10 . 15 . 224 . 158 / 30
				-	10 . 15 . 224 . 159 / 30
	41	10.15.224.160 / 30	VACANTE	-	10 . 15 . 224 . 160 / 30
					10 . 15 . 224 . 161 / 30
					10 . 15 . 224 . 162 / 30
				-	10 . 15 . 224 . 163 / 30
	42	10.15.224.164 / 30	VACANTE	-	10 . 15 . 224 . 164 / 30
					10 . 15 . 224 . 165 / 30
					10 . 15 . 224 . 166 / 30
				-	10 . 15 . 224 . 167 / 30
	-	-	-	-	-
					-
					-
				-	-
	-	-	-	-	-
					-
					-
				-	
	2048 (última)	10.15.31.252 / 30	VACANTE	-	10 . 15 . 31 . 252 / 30
					10 . 15 . 31 . 253 / 30
					10 . 15 . 31 . 254 / 30
				-	10 . 15 . 31 . 255 / 30

APPENDIX C

1. C1 – Present Architecture of the SAM Network

1.1 ICAO, the Contracting Party on behalf of the Member States, under Technical Cooperation Project RLA03/901, is the organization responsible for coordination, tendering and management of the SAM Digital Communication Network (REDDIG).

1.2 The countries and nodes, together with their basic geographic coordinates, that are a part of this tender, are listed in Table 2.

Country	Node	Indicative	Latitude	Longitude
Argentina	Ezeiza	SAEZ	34° 49' 25" S	58° 31' 43" W
Bolivia	La Paz	SLLP	16° 30' 29" S	68° 11' 24" W
Brazil	Manaos	SBMN	03° 02' 19" S	60° 02' 59" W
	Recife	SBRE	08° 07' 36" S	34° 55' 23" W
	Curitiba	SBCT	25° 31' 43" S	49° 10' 33" W
Chile	Santiago	SCEL	33° 23' 26" S	70° 47' 09" W
Colombia	Bogota	SKED	04° 42' 05" N	74° 08' 48" W
Ecuador	Guayaquil	SEGU	02° 09' 29" S	79° 53' 02" W
Guyana	Georgetown	SYGC	06° 29' 56" N	58° 15' 16" W
French Guiana	Cayenne	SOCA	04° 49' 11" N	52° 21' 38" W
Paraguay	Asuncion	SGAS	25° 14' 24" S	57° 31' 09" W
Peru	Lima	SPIM	12° 01' 19" S	77° 06' 52" W
Suriname	Paramaribo	SMPM	05° 27' 10" N	55° 11' 16" W
Trinidad and Tobago	Piarco	TTZP	10° 35' 44" N	61° 20' 36" W
Uruguay	Montevideo	SUMU	34° 50' 15" S	56° 01' 49" W
Venezuela	Maiquetia	SVMI	10° 36' 12" N	66° 59' 26" W

Table 2: Location of the REDDIG Nodes

1.3 Figure 1 shows the basic topology of the current REDDIG with its sixteen nodes.

Figure 1: Current REDDIG Topology

In addition to that outlined in Figure 1, the REDDIG is also interconnected with the MEVAII network that serves the Central American and Caribbean countries and the United States. REDDIG uses the nodes of Bogota (Colombia) and Maiquetia (Venezuela), as described in Figure 2, to make that interconnection.

1.4

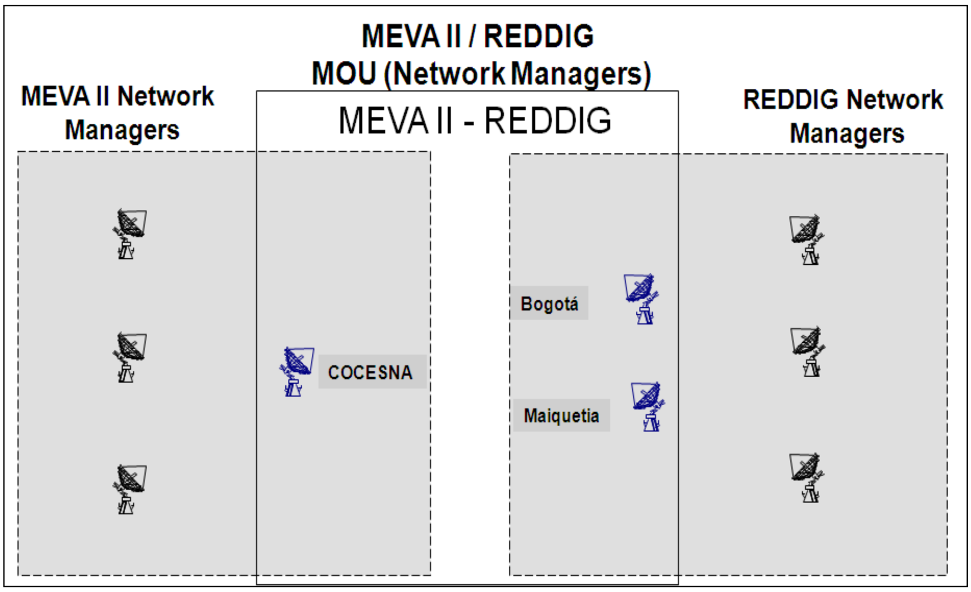

Figure 2. MEVA II - REDDIG Interconnection

1.5 The basic characteristics of the current network are the following:

a) REDDIG is a meshed network that uses VSAT (Very Small Aperture Terminal) technology with 3.7m antennas and Band C (4-6 GHz), utilizing the INTELSAT IS-14 satellite that is located at 315°E. At present, a 4.4 MHz capacity is rented to meet REDDIG application requirements.
b) REDDIG possesses a total of 1,328 Kbps to handle traffic between all network terminals, which are equivalent to 83 16 Kbit/s bursts.
c) INTELSAT is the current satellite provider, since the International Civil Aviation Organization (ICAO), as a United Nations (UN) Organization, is an INTELSAT signatory by law and thus responsible for reserving and paying for the required bandwidth.
d) The REDDIG network uses band C (4-6 GHz) because some of its nodes are located in zones where weather conditions make that use necessary.
e) The main equipment (indoor and outdoor), together with the software used, are described in Appendix A, while the main voice and data services are described in Appendix B.
f) The network also supports RC&M (Remote Control & Monitoring) for the efficient management of its resources. There are two network control centres (NCCs), the main one being located in Manaus (Brazil) and the alternate in Ezeiza (Argentina).
g) The interconnection between the MEVA II and REDDIG networks maintains the individual basic characteristics of the two networks insofar as management and control are concerned. Nevertheless, it adds a MEVA II modem in the Bogota (Colombia) and Maiquetia (Venezuela) REDDIG nodes and a REDDIG modem to the COCESNA (Honduras) MEVA II node.

2. C2 – Future network architecture

2.1 REDDIG II arose from the need to maintain air navigation communications and services among the various air traffic units of the Region that are currently being served by the REDDIG, and to implement the backbone of the Aeronautical Telecommunication Network (ATN).

2.2 Figure 3 presents an outline of the basic topology required for REDDIG II.

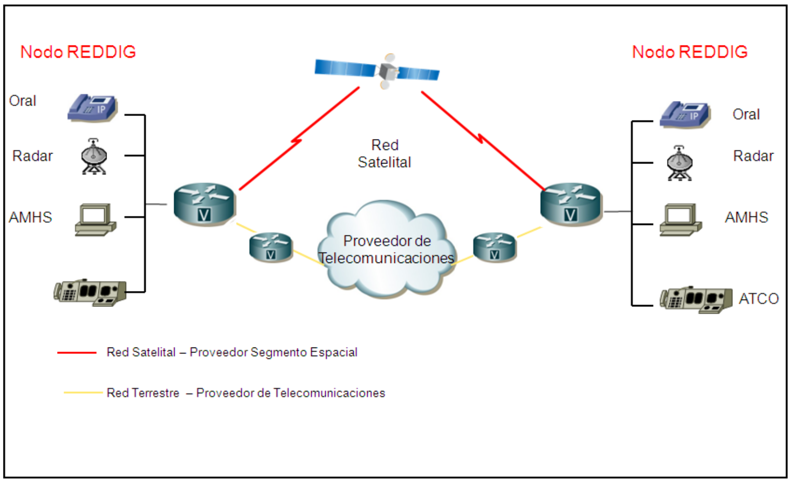

Figure 3: Basic REDDIG II Topology

2.3 As can be seen in Figure 3, REDDIG II will have two segments: a satellite transmission (VSAT) segment, and a ground segment based on Multiprotocol Label Switching (MPLS) technology. The satellite backbone will be the main system, and the ground segment, being IP, will increase flexibility for the loading of new applications, and will also increase the network's overall availability. If the main network fails, switching to the ground backbone will be automatic.

2.4 The topology of the satellite and terrestrial networks will be fully meshed, flexible and scalable in order to facilitate infrastructure growth. In addition, it will be highly available, thanks to: intelligence distributed within its nodes and with no common failure point, traffic prioritization, dynamic bandwidth management and management by demand, automatic alternate traffic routing in the event of a failure and a global, integrated, "future-proof" common network management system (NMS) to allow for migration to other network technologies.

2.5 The routing system to be implemented has important characteristics for purposes of this document, inasmuch as it must support internal gateway protocols (IGP), such as RIP (Versions 1 and 2) and OSPF, and external border gateway protocol BGP-4.

2.6 The main requirements of the VSAT system will be:

a) Hubless network with no common failure point. All stations will be identical and no specialized stations must exist. Each station must be capable of acting as a time reference station for the satellite network, with only occasional updating of software.
b) Secure control system via pre-established and programmable rotation defined by the master and supporting terminals, automatic switching if the master station fails, or synchronized architecture that does not require a master station.
c) Full-meshed topology: the necessary links should be established to satisfy network topology and communication requirements.
d) All communications should be established through a simple satellite hop.
e) Satellite links will have a better bit error rate (BER) than 1 E-7.
f) Band C operation.

2.7 The REDDIG II terrestrial backbone will operate as a multiservice infrastructure and should be provided by a Multiservice IP Platform that is logically independent and isolated from any other network, particularly the public environment of the Internet. The main requirements are described as follows:

a) Monthly availability of each link at least 99.5% of the time.
b) Delay of less than 60 m.
c) RTT for a 64-byte packet in a communication between two stations of no more than 150 m in 95% of the measurements made during a 10-second minimum time window.
d) BER smaller than 10^{-7} 99.5% of the time.

APPENDIX D

1. D1 – Air navigation support service requirements in the SAM Region, including those foreseen for the short, medium and long term.

1.1 The list of air navigation support service requirements in the SAM Region, including those foreseen for the short, medium and long term, to be transported over the new digital network, consist of the:

1.1.1 Current services

1.1.1.1 Those deriving from the requirements contained in the Air Navigation Plan for the Caribbean and South American Regions, almost all of which are operational, as follows:

a) Table CNS1A (AFTN Plan).
b) Table CNS1C (ATS direct speech circuits).

1.1.2 Future services

a) Those stemming from the MEVA II – REDDIG interconnection.
b) Teleconferencing Service for flow management units (FMU) or flow management positions (FMP), to be carried out daily among all of the Region's units, initially for twenty users.
c) Exchange of flight plans and/or radar information using conventional methods, in accordance with the respective MoUs (Memorandums of Understanding) that have been or are to be signed.
d) AMHS interconnection requirements, which will progressively replace the AFTN service, in accordance with the respective MoUs (Memorandums of Understanding) that have been or are to be signed.
e) AIDC interconnection requirements, which will progressively replace the ATS speech service.
f) Exchange of ADS-B data and their multilateration among all ACCs of adjacent FIRs.
g) Interconnection of automated systems among the ACCs of adjacent FIRs, using Asterix 62 and 63.
h) AIM requirements: no specific requirement is as yet available in this regard.

1.2 Table B-1 describes the minimum interfaces that routers to be installed in each State should have for REDDIG II implementation.

State	Site	Minimum interfaces					
		Universal I/O	Ethernet	Digital	E&M	FXO	FXS
Argentina	Ezeiza	11	1	0	11	0	1
Bolivia	La Paz	4	1	0	4	0	4
Brazil	Curitiba	4	1	0	6	2	1
	Manaos	6	1	0	7	0	5
	Recife	1	1	0	7	0	1
Chile	Santiago	2	1	0	8	0	0
Colombia	Bogota	7	1	1	0	0	0

State	Site	Minimum interfaces					
		Universal I/O	Ethernet	Digital	E&M	FXO	FXS
Ecuador	Guayaquil	3	1	1	0	0	0
French Guiana	Rochambeau	2	1	0	0	0	5
Guyana	Georgetown	4	1	0	0	0	5
Paraguay	Asuncion	3	1	0	3	0	3
Peru	Lima	9	1	1	0	0	0
Suriname	Panamaribo	3	1	0	0	0	4
Trinidad and Tobago	Piarco	2	1	0	0	0	6
Uruguay	Montevideo	2	1	0	0	4	5
Venezuela	Maiquetía	10	1	0	7	0	4

Table B-1: Future Interfaces for REDDIG II

1.3 Table B-2 presents the estimated bandwidth needed to support the new services to be implemented in the SAM Region for REDDIG II.

State	Site	Service (each in Kbps)			
		AFTN	Radar	AMHS	ADS-B
Argentina	Ezeiza		76.8	28.8	19.2
Bolivia	La Paz		115.2	14.4	19.2
Brazil	Curitiba		76.8	19.2	19.2
	Manaos	9.6	134.4	33.6	19.2
	Recife		0	4.8	19.2
Chile	Santiago		57.6	9.6	19.2
Colombia	Bogota	19.2	76.8	38.4	19.2
Ecuador	Guayaquil		38.4	14.4	19.2
French Guiana	Rochambeau		38.4	9.6	19.2
Guyana	Georgetown		57.6	19.2	19.2
Paraguay	Asuncion		57.6	9.6	19.2
Peru	Lima	9.6	96	43.2	19.2
Suriname	Panamaribo		76.8	14.4	19.2
Trinidad and Tobago	Piarco		19.2	9.6	19.2
Uruguay	Montevideo		19.2	9.6	19.2
Venezuela	Maiquetia		76.8	38.4	19.2
Partial figures (Kbps)		38.4	1017.6	316.8	307.2
Partial global figure (Kbps)		1680			
AFTN difference		-103.2			

State	Site	Service (each in Kbps)			
		AFTN	Radar	AMHS	ADS-B
Net increase in bandwidth		1576.8			

Table B-2: Estimated additional bandwidth

APPENDIX E

TABLE CNS 1Ba – ROUTERS REGIONAL PLAN
SAM REGION

Administration and Location	Type of Router	Type of Interconnection	ConnectedRouter	Link Speed	Link Protocol	Via	Target Date	Remarks
1	2	3	4	5	6	7	8	9
Argentina/Buenos Aires	IP	Inter Regional	AFI (Johannesburg)	64K	IPv6	CAFSAT	TBD	
	IP	Intra Regional	Bolivia (La Paz)	64K	IPv4	REDDIG	2014	
	IP	Intra Regional	Chile (Santiago)	64K	IPv4	REDDIG	2012	
	IP	Intra Regional	Brazil (Brasilia)	64K	IPv4	REDDIG	2012	
	IP	Intra Regional	Paraguay (Asuncion)	64K	IPv4	REDDIG	2012	
	IP	Intra Regional	Peru (Lima)	64K	IPv4	REDDIG	2011	
	IP	Intra Regional	Uruguay (Montevideo)	64K	IPv4	REDDIG	2011	
Bolivia/La Paz	IP	Intra Regional	Argentina (Buenos Aires)	64K	IPv4	REDDIG	2014	
	IP	Intra Regional	Brazil (Brasilia)	64K	IPv4	REDDIG	2014	
	IP	Intra Regional	Peru (Lima)	64K	IPv4	REDDIG	2014	
Brazil/Brasilia	IP	Inter Regional	AFI (Dakar)	TBD	IPv6	CAFSAT	TBD	
	IP	Intra Regional	Argentina (Buenos Aires)	64K	IPv4	REDDIG	2012	
	IP	Intra Regional	Bolivia (La Paz)	64K	IPv4	REDDIG	2014	
	IP	Inter Regional	EUR (Madrid)	64K	IPv6	PTT	2014	
	IP	Inter Regional	NAM (Atlanta)	64K	IPv4	MEVA II/ REDDIG	2014	Circuit via Bogota
	IP	Intra Regional	Paraguay (Asuncion)	64K	IPv4	REDDIG	2014	
	IP	Intra Regional	Uruguay (Montevideo)	64K	IPv4	REDDIG	2014	
Brazil/Manaus	IP	Intra Regional	Colombia (Bogota)	64K	IPv4	REDDIG	2014	
	IP	Intra Regional	Guyana (Georgetown)	64K	IPv4	REDDIG	2014	
	IP	Intra Regional	French Guiana (Cayenne)	64K	IPv4	REDDIG	2014	
	IP	Intra Regional	Peru (Lima)	64K	IPv4	REDDIG	2012	
	IP	Intra Regional	Suriname (Paramaribo)	64K	IPv4	REDDIG	2014	
	IP	Intra Regional	Venezuela (Caracas)	64K	IPv4	REDDIG	2012	
Chile/Santiago	IP	Intra Regional	Argentina (Buenos Aires)	64K	IPv4	REDDIG	2012	
	IP	Inter Regional	PAC (Christchurch)	TBD	IPv4	PTT	TBD	
	IP	Intra Regional	Peru (Lima)	64K	IPv4	REDDIG	2014	
Colombia/Bogota	IP	Intra Regional	Brazil (Manaus)	64K	IPv4	REDDIG	2014	

Administration and Location	Type of Router	Type of Interconnection	ConnectedRouter	Link Speed	Link Protocol	Via	Target Date	Remarks
1	2	3	4	5	6	7	8	9
	IP	Inter Regional	CAR	64K	IPv4	MEVAII/REDDIG	2014	
	IP	Intra Regional	Ecuador (Guayaquil)	64K	IPv4	REDDIG	2014	
	IP	Inter Regional	NAM (Atlanta)	2x 64K	IPv4	MEVA II / REDDIG	2014	Connection of Colombia and Brazil
	IP	Intra Regional	Panama	64k	IPv4	MEVAII/REDDIG	2014	
	IP	Intra Regional	Peru (Lima)	64K	IPv4	REDDIG	2010	
	IP	Intra Regional	Venezuela (Caracas)	64K	IPv4	REDDIG	2014	
Ecuador/Guayaquil	IP	Inter Regional	CAR	64K	IPv4	MEVA II / REDDIG	2014	
	IP	Intra Regional	Colombia (Bogota)	64K	IPv4	REDDIG	2014	
	IP	Intra Regional	Peru (Lima)	64K	IPv4	REDDIG	2012	
	IP	Intra Regional	Venezuela (Caracas)	64K	IPv4	REDDIG	2014	
French Guiana/Cayenne	IP	Intra Regional	Brazil (Manaus)	64K	IPv4	REDDIG	2014	
	IP	Intra Regional	Suriname (Paramaribo)	64K	IPv4	REDDIG	2014	
Guyana/Georgetown	IP	Intra Regional	Brazil (Manaos)	64K	IPv4	REDDIG	2014	
	IP	Inter Regional	CAR	64K	IPv4	REDDIG	2014	
	IP	Intra Regional	Suriname (Paramaribo)	64K	IPv4	REDDIG	2011	
	IP	Intra Regional	Venezuela (Caracas)	64K	IPv4	REDDIG	2014	
Panama/Panama	IP	Inter Regional	CAR	64K	IPv4	CAMSAT	2012	
	IP	Intra Regional	Colombia (Bogota)	64K	IPv4	MEVAII / REDDIG	2014	
	IP	Inter Regional	NAM (Atlanta)	64K	IPv4	MEVA II	2014	
Paraguay/Asuncion	IP	Intra Regional	Argentina (Buenos Aires)	64K	IPv4	REDDIG	2012	
	IP	Intra Regional	Brazil (Brasilia)	64K	IPv4	REDDIG	2014	
Peru/Lima	IP	Intra Regional	Argentina (Buenos Aires)	64K	IPv4	REDDIG	2011	
	IP	Intra Regional	Bolivia (La Paz)	64K	IPv4	REDDIG	2014	
	IP	Intra Regional	Brazil (Manaos)	64K	IPv4	REDDIG	2012	
	IP	Intra Regional	Chile (Santiago)	64K	IPv4	REDDIG	2014	

Administration and Location	Type of Router	Type of Interconnection	ConnectedRouter	Link Speed	Link Protocol	Via	Target Date	Remarks
1	2	3	4	5	6	7	8	9
	IP	Intra Regional	Colombia (Bogota)	64K	IPv4	REDDIG	2010	
	IP	Intra Regional	Ecuador (Guayaquil)	64K	IPv4	REDDIG	2012	
	IP	Inter Regional	NAM (Atlanta)	64K	IPv4	MEVAII/REDDIG	2014	Via Bogota, Colombia
	IP	Intra Regional	Venezuela (Caracas)	64K	IPv4	REDDIG	2014	
Suriname/Paramaribo	IP	Intra Regional	Brazil (Manaos)	64K	IPv4	REDDIG	2014	
	IP	Intra Regional	French Guiana (Cayenne)	64K	IPv4	REDDIG	2011	
	IP	Intra Regional	Venezuela (Caracas)	64K	IPv4	REDDIG	2014	
Uruguay/Montevideo	IP	Intra Regional	Argentina (Buenos Aires)	64K	IPv4	REDDIG	2011	
	IP	Intra Regional	Brazil (Brasilia)	64K	IPv4	REDDIG	2014	
Venezuela/Caracas	IP	Inter Regional	CAR	128K	IPv4	MEVA II / REDDIG	2014	
	IP	Inter Regional	EUR (Madrid)	64K	IPv6	PTT	2014	
	IP	Intra Regional	Brazil (Manaus)	64K	IPv4	REDDIG	2012	
	IP	Intra Regional	Colombia (Bogota)	64K	IPv4	REDDIG	2014	
	IP	Intra Regional	Ecuador (Quito)	64K	IPv4	REDDIG	2014	
	IP	Intra Regional	Guyana (Georgetown)	64K	IPv4	REDDIG	2014	
	IP	Intra Regional	Suriname (Paramaribo)	64K	IPv4	REDDIG	2014	

APPENDIX F

PRIVATE AS NUMBERS

STATE	TYPE OF ROUTER	AS NUMBER
Argentina	IP	64517
Bolivia	IP	64529
Brazil	IP	64531
Chile	IP	64543
Colombia	IP	64545
Ecuador	IP	64558
Guyana	IP	64574
French Guiana	IP	64575
Panama	IP	65261
Paraguay	IP	65263
Peru	IP	65264
Suriname	IP	65288
Uruguay	IP	65302
Venezuela	IP	64528

APPENDIX E

PROJECT ATN ARCHITECTURE IN THE SAM REGION

SAM Region	**PROJECT DESRICPTION (PD)**	**PD N° D1**	
Programme	**Project Title**	**Starting Date**	**Ending Date**
Ground-ground and Air-ground Telecommunications Infrastructure (*Programme Coordinator: Onofrio Smarrelli)*	ATN Architecture in the SAM Region *Project Coordinator: Athayde Licério Vieira Frauche (Brazil)* *Contributing experts: Omar Gouarnalusse (Argentina), Michel Areno (France), Jose Luis Paredes (Peru), Jesús Bolívar (Venezuela), Christian Amaris de León (Colombia) and Hernando Lara (Bolivia)*	March 2010	March 2015
Objective	Study and implementation of optimum architecture for an IP protocol backbone network (REDDIG II) for the SAM Region		
Scope	Study and implementation of an IP backbone network for the SAM Region, including an optimum configuration and considering, among other deliverables, the following: • Technical review of the regional telecommunications networks (ground, satellite or mixed) for the implementation of ATN under a cost-benefit analysis • Holding of trials to determine the ATN bandwidth necessary to support ground applications • IP addressing scheme (IPv4 and IPv6) and analysis of the data communications infrastructure in support to ATS operational requirements in the short, medium and long term • Support in the bidding process by TCB (Montreal) and in the implementation of the IP backbone network for the SAM Region • Implementation of REDDIG II		
Metrics	• Percentage concluded of the study for an IP backbone network for the SAM Region • Drafting of technical specifications for REDDIG II • REDDIG II implementation percentage		
Strategy	• All tasks will be conducted by experts nominated by States of the SAM Region members of the project *ATN Architecture in the SAM Region*, under management of the project coordinator, in coordination with the programme coordinator. Communications among project members, as well as between the project coordinator and programme coordinator, shall be carried out through teleconferences and the Internet. In addition, the programme coordinator, together with the project coordinator and the contributing experts, can convene at SAM/IG implementation meetings • Once studies are completed and REDDIG II is implemented, the results will be submitted to the ICAO programme coordinator as a final consolidated document for its analysis, review, approval and presentation at the GREPECAS PPRC		

Goals	•
Justification	• A study on an ATN IP backbone network for the SAM Region will permit defining the optimum communications network architecture for said Region, currently mainly based on REDDIG (satellite digital communications network). • To arrive to the conclusion on the better network infrastructure, the determining of the current applications demand in terms of band width is considered very important. In this respect, States are carrying out tests, mainly AMHS, to determine the associated space segment. The action is considered as the beginning of the network's cost-benefit relationship research. • In addition, the increasing band width requirements for new services such as automation, surveillance, ATFM and meteorology. Also, a close relationship with the other programmes and their respective projects is necessary, with the aim of collecting the operational requirements demanded by the mentioned applications and their respective tentative implementation dates • After developing all tasks necessary for determining the better network infrastructure, technical specifications for the purchasing and implementation of the SAM backbone network (REDDIG II) will be drafted • This project ends once the SAM IP backbone network (REDDIG II) is implemented • This project contributes to the implementation of SAM PFF CNS 01, CNS04, ATM 05, ATM 06, MET 04 and AIM 02 of the *Air Navigation System Performance-Based Implementation Plan for the SAM Region (SAM PBIP)*
Related Projects	• Air Navigation Systems in Support of PBN • Automation • Improve ATM Situational Awareness • Implementation of the ICAO New Flight Plan Format • ATN Ground-ground and Air-ground Applications

Project Deliverables	Relationship with Performance Based Regional Plan (PFF)	Responsible	Status of Implementation[1]	Delivery Date	Remarks
Analysis of the current SAM communications network (REDDIG)	PFF SAM CNS01	REDDIG Administration, Project Coordinator and Omar Gouarnalusse (Argentina)		August 2010	Completed
Analysis of the current MEVA II/ REDDIG interconnection	PFF SAM CNS01	REDDIG Administration		June 2011	Completed
Analysis of the AMHS band width impact on the current REDDIG satellite infrastructure	PFF SAM CNS01	Project Coordinator and Omar Gouarnalusse (Argentina)		September 2010	Completed
Long term applications requirements in the SAM Region	PFF SAM CNS01 PFF SAM CNS 04 PFF SAM MET 04 PFFs SAM ATM 05 and 06 PFF SAM AIM 02	ICAO		September 2010	Completed

1 ***Gray****: Activity has not started*
Green*: Activity has or will deliver planned milestone as scheduled*
Yellow*: Activity is behind schedule on milestone, but still within acceptable parameters to deliver milestone on time*
Red*: Activity has failed to deliver milestone on time, mitigation measures need to be identified and implemented*

Project Deliverables	Relationship with Performance Based Regional Plan (PFF)	Responsible	Status of Implementation[1]	Delivery Date	Remarks
Comparative study on satellite, ground and mixed (satellite and ground) IP based network models for the SAM Region	PFF SAM CNS 01	Project Coordinator, Omar Gouarnalusse (Argentina) and REDDIG Administration		October 2010	Completed Approved by REDDIG Member States
Definition of ATN IP network infrastructure model for the SAM Region	PFF SAM CNS 01	Project Coordinator, Omar Gouarnalusse (Argentina) and REDDIG Administration		October 2010	Completed Approved by REDDIG Member States
Completion of IPv4 addressing plan for the SAM Region	PFF SAM CNS 01	Project Coordinator and Omar Gouarnalusse (Argentina)		August 2010	Completed The addressing scheme was approved through GREPECAS Conclusion 16/37
Drafting of technical specifications for REDDIG II	PFF SAM CNS01 PFF SAM CNS 04 PFF SAM MET 04 PFFs SAM ATM 05 and 06 PFF SAM AIM 02	Project Coordinator, Omar Gouarnalusse (Argentina) and REDDIG Administration		August 2011	Completed and approved by REDDIG Member States
Drafting of safety guidelines for REDDIG	PFF SAM CNS 01	REDDIG Administration		May 2012	Completed for presentation at SAM/IG/11 meeting

Project Deliverables	Relationship with Performance Based Regional Plan (PFF)	Responsible	Status of Implementation[1]	Delivery Date	Remarks
Drafting of IP Routing Policy	PFF SAM CNS 01	Project Coordinator		October 2013	Completed for presentation at SAM/IG/11 meeting
Support in the bidding process and in the offer evaluation		Project Coordinator, Omar Gouarnalusse (Argentina), Michel Areno (France), José Luis Paredes (Peru), Jesus Bolívar (Venezuela), Hernando Lara (Bolivia), Christian Amaris (Colombia) and REDDIG Administration		April 2012	Completed. The bidding was conducted by TCB, under coordination with the ICAO Regional office. The evaluation process will count with the REDDIG Administration and CNS experts selected by the REDDIG Member States
Support in the implementation of REDDIG II		REDDIG Administration, Project Coordinator and Omar Gouarnalusse (Argentina) REDDIG II focal points		November 2013-March 2015	This activity is scheduled to start at the end of 2013
Monitor the ATN architecture project activities in the SAM Region		ICAO		March 2010-December 2015	
Resources necessary	Economic contribution necessary for the implementation of REDDIG II				

APPENDIX F

PROJECT ATN GROUND-GROUND AND AIR GROUND APPLICATIONS IN THE SAM REGION

SAM Region	**PROJECT DESCRIPTION (PD)**	**PD N° D2**	
Programme	**Project Title**	**Starting Date**	**Ending Date**
Ground-ground and Air-ground Telecommunications Infrastructure (*Programme Coordinator:* *Onofrio Smarrelli)*	ATN Ground-ground and Air-ground Applications in the SAM Region *Project Coordinator: Omar Gouarnalusse (Argentina)* *Contributing experts: Javier Vittor (Argentina), Ruben Guillermo Silva (Argentina) Andres Jansen (Brazil)*	May 2010	June 2016
Objective	Develop the implementation of ATN ground-ground and air-ground applications in the SAM Region		
Scope	Implementation of SAM ATN ground-ground and air-ground applications, including, at least: • Operational integration of international AMHS connections in the SAM Region • Operational integration of international AIDC connections in the SAM Region • Guidelines for the implementation of ground-air data in the SAM Region • Guideline for the implementation of AIDC		
Metrics	• Number of AMHS interconnections as per CAR/SAM FASID Table 1Bb • Number of AIDC interconnections as per CAR/SAM FASID Table 1Bb • Drafting of following guidelines: Guideline for the implementation of AIDC / Guideline for the implementation of ground-air data links in terminal, approach and aerodrome areas / DCL, DATIS and DVOLMET / CPDLC service through VDL in the SAM Region		
Strategy	• All tasks will be conducted by experts nominated by States and organizations of the SAM Region members of the project *ATN Ground-ground and Air-ground Applications in the SAM Region*, under management of the project coordinator, in coordination with the programme coordinator. Communications among Project members, as well as between the Project coordinator and programme coordinator, shall be carried out through teleconferences and the Internet. In addition, the programme coordinator, together with the project coordinator and the contributing experts, can convene at SAM/IG implementation meetings • Once studies are completed, the results will be submitted to the ICAO programme coordinator as a final consolidated document for its analysis, review, approval and presentation at the GREPECAS PPRC		

Goals	• Complete all AMHS interconnections by December 2015 • Complete the drafting of MoU for the interconnection of AMHS by mid-2013 • Complete the migration towards the implementation of AMHS interconnection through IP protocol by December 2015 • Complete AIDC installation between adjacent ACCs by mid-2016 • Complete the drafting of MoU for AIDS systems interconnection by the end of 2013 • Complete AIDC installation between adjacent FIRs by mid-2016 • Complete the drafting of guideline material for the implementation of AIDC; for the installation of ground/air data links in terminal, approach and aerodrome areas; DCL, DATS and DVOLMET; CPDLC service through VDL in the SAM Region by December 2013.
Justification	• The implementation of ground-ground and air-ground data communications infrastructure will contribute to the reduction of air traffic control incidents, increasing the capacity of the transition of information with regard to the currently analogue based applications • This project contributes to the implementation of the SAM PFF SAM CNS 01, CNS 02, ATM 05, ATM 06, MET 03, MET04 and AIM 02 of the *Air Navigation System Performance-Based Implementation Plan for the SAM Region (SAM PBIP)* • This Project contributes towards the implementation of ASBU Modules B0-25, B0-40, B0-105 and B0-30
Related Projects	• Automation (systems interconnection) • ATFM • Improve ATM Situational Awareness • Implementation of the ICAO New Flight Plan Format

Project Deliverables	Relationship with Performance Based Regional Plan (PFF)	Responsible	Status of Implementation[1]	Delivery Date	Remarks
Review of the regional strategy for the implementation of ground-ground and air-ground applications in the SAM Region	PFF SAM CNS 01 CNS 02 B0-40	Omar Gouarnalusse (Argentina)		June 2012	An initial review of the strategy was presented at SAM/IG/8 meeting (Lima, Peru, 10-14 October 2011). In July 2012, the Project Coordinator presented a preliminary version of the Guide, which was reviewed by the Programme Coordinator and presented at SAM/IG/10 meeting for its review and approval
Guideline for the use of AIDC with the aim of reducing coordination errors	PFF SAM CNS 01 ATM 06 B0-25	Javier Vittor (Argentina) Ruben Guillermo Silva (Argentina)		April 2013	The guideline will is based on the Argentinean experience in the IP AIDC implementation between the Cordoba and Ezeiza ACCs. The GREPECAS-approved *Interface control document* (ICD) for data communications among ATS units in the Caribbean and South American Regions will be reviewed. The document will be presented at SAM/IG/11 meeting.
Guideline for the implementation ground-air data links in the SAM Region	PFF SAM CNS 02 ATM 06 B0-40	Andrés Jansen (Brazil)		October 2013	The guideline will be based on the Brazilian experience in the implementation of ground-air data links. In same, DATIS, DVOLMET and DCL, as well as CPDLC service through VDL, among others, will be included.

1 ***Gray***: *Activity has not started*
Green: *Activity has or will deliver planned milestone as scheduled*
Yellow: *Activity is behind schedule on milestone, but still within acceptable parameters to deliver milestone on time*
Red: *Activity has failed to deliver milestone on time, mitigation measures need to be identified and implemented*

Project Deliverables	Relationship with Performance Based Regional Plan (PFF)	Responsible	Status of Implementation[1]	Delivery Date	Remarks
Operational integration of AMHS among States	PFF SAM CNS 01 ATM 05 ATM 06 MET 03 MET 04 AIM 02 B0-25 B0-105 B0-30	States / Project Coordinator / Programme Coordinator		December 2015	Of all the AMHS installed in the Region, the following are interconnected in AMHS (P1 Protocol) Argentina-Paraguay, Colombia-Peru and Guyana-Suriname Other States are in the process of implementation, having drafted and signed MoUs to this end Follow-up to the implementation of AMHS integration is carried out at SAM/IG meetings
Operational integration of AIDC service between adjacent ACCs	PFF SAM CNS 01 ATM 06 B0-25	States / Project Coordinator / Programme Coordinator		June 2016	To date no AIDC interconnection trials have been held between the Ezeiza and Cordoba ACCs. The integration is still not being used operationally Many States of the Region have drafted and signed MoUs to carry out the integration
Monitor the implementation of ATN ground-ground and air-ground applications activities in the SAM Region		ICAO		March 2010- June 2016	
Resources necessary	Designation of experts for the conduct of some of the deliverables				

APPENDIX G

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

ITEM	ACTIVITY	RESPONSIBLE	EXPECTED RESULT	STATUS	FINALIZATION DATE
1	2	3	4	5	6
1	Review of the ATN Regional Plan as regards AMHS implementation	Secretariat	Revised ATN ground ground applications plan (Table CNS 1Bb)	Completed	Jun 2009
2	Review and assignment of intra-regional routers IP addressing	Secretariat	Assignment of IP addressing	Completed	Jun 2009
3	Review of CAAAS addressing plan	SAM States	Revised CAAS addressing Plan	Completed	Jun 2009
4	Prepare interconnection protocol tests to determine bandwidth required for transmission of AMHS messages between MTAs through REDDIG	RLA/06/901 project CNS Expert	Protocol interconnection tests. A guide for the operational interconnection of AMHS systems was drafted	Completed	Dec 2009
5	Preparation of Guide for the Operational Interconnection of AMHS Systems in the SAM Region	RLA/06/901 project CNS Expert	Guide for the operational interconnection of AMHS systems in the SAM Region	Completed	Oct 2009
6	Drafting of a model MoU for the interconnection of AMHS	Argentina	Model MoU for the interconnection of AMHS	Completed	Oct 2009
7	MoU for the interconnection of AMHS currently implemented in the SAM Region: 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) Bolivia-Paraguay The AMHS interconnection MoU in French Guiana (France) and Uruguay should be drafted once AMHS installation is completed at national level.	SAM States involved	MoU for interconnection of AMHS systems between SAM States having AMHS implemented	**Valid** a), b) c), d), f), g), i), l), q) & v) completed	h) TBD j) Oct 2013 k) TBD m) TBD n) TBD o) TBD p) TBD r) TBD s) TBD t) TBD u) TBD w) TBD x) TBD y) TBD

ITEM	ACTIVITY	RESPONSIBLE	EXPECTED RESULT	STATUS	FINALIZATION DATE
1	2	3	4	5	6
8	Phase I Interconnection trials between MTAs of: 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 Types of tests to carry out: Network transportation; Network connectivity; Message exchange; Preparatory phase. **Note**: Inclusion has been made of only the AMHS interconnected between States having implemented and signed the MoU.	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	**Valid** a), f), g) message exchange trials were held between CIPE (Argentina)-Brasilia (Brazil) MTAs; the Manaos (Brazil)-Lima (Peru) MTAs, and the CIPE (Argentina)-Lima (Peru) MTAs. 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. b), d), h) and i) Operational interconnection trials completed c), e), j), and k) No tests carried out f) operational trial pending	a) Jun 2012 Completed b) Mar 2012 Completed c) Jun 2013 d) Oct 2010 Completed e) TBD f) TBD g) Oct 2013 h) Jun 2011 Completed i) Jul 2012 Completed j) TBD k) TBD
9	Operational interconnection implementation at the following MTAs: a) Argentina-Paraguay b) Argentina-Brazil c) Argentina-Chile d) Argentina-Peru e) Brazil-Paraguay f) Brazil-Peru g) Colombia-Peru h) Guyana-Suriname i) Ecuador-Peru j) Brazil-Colombia k) Peru-Venezuela **Note**: Inclusion has been made of only the AMHS interconnected between States having implemented and signed the MoU.	Argentina, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, and Venezuela	Operational implementation of AMHS systems	**Valid** AMHS interconnection completed between following MTA, using P1 protocol and operational: Colombia-Peru Guyana-Suriname Argentina-Paraguay Ecuador-Peru	a) Mar 2012 Operational b) Sep 2013 c) TBD d) TBD e) Jul 2013 f) Oct 2013 g) Nov 2010 Operational h) Jul 2011 Operational i) Jul 2012 Operational j) TBD k) TBD

APPENDIX H

International Civil Aviation Organization

SAM Region

GUIDE FOR THE IMPLEMENTATION

OF AIDC

THROUGH THE INTERCONNECTION

OF

ADJACENT AUTOMATED CENTRES

Lima, Peru – April 2013

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LIST OF TABLES

LIST OF GRAPHS

REFERENCES

Document ID	Name of document
ICAO 4444	Air Traffic Management
ICAO Annex 10, Volume II	Aeronautical Telecommunications
ICAO Annex 11	Air Traffic Services
ICAO Doc 9694	Manual of Air Traffic Services – Data Link Applications
ICAO Doc 9880	Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO / OSI Standards and Protocols PART II – Ground-Ground Applications Between ATS Data Communication Facilities (AIDC)
Asia/Pacific Regional Doc	Asia/Pacific Regional ICD for AIDC
CAR/SAM ICD Doc	CAR/SAM AIDC ICD

PURPOSE

The purpose of this document is to serve as practical guidance for the implementation of AIDC between two adjacent automated centres of the SAM Region.

The development of this document for the implementation of AIDC and its interconnection is contemplated amongst the activities of Regional Project RLA/06/901, *Assistance for the implementation of a regional ATM system, taking into account the ATM operational concept and the corresponding technological support in communications, navigation and surveillance (CNS).*

This document will support the States of the Region in the implementation of AIDC through the interconnection of automated systems between adjacent ACCs, and its development was discussed at the Tenth Workshop/Meeting of the SAM Implementation Group (SAM/IG/10), held in Lima on 1-5 October 2012, and approved by the Sixth Coordination Meeting of Project RLA/06/901 (Lima, 21-23 November 2012).

SCOPE

The two main aspects contained in this document for AIDC implementation are:

technical aspects

operational aspects

implemented in a setting of adjacent automated centres.

CHAPTER I

1. GENERAL

1.1. Introduction

1.1.1. One of the key features of the future air traffic management system is the bidirectional exchange of data between the aircraft and the ATC system, and between ATC systems. Communications with the aircraft increasingly tend towards the use of digital data links. At the same time, the automatic exchange of data between ATC systems will support the timely broadcast of flight data, especially for coordination and transfer of flights between ATS units.

1.1.2. The AIDC application shall provide important benefits, including:

a) Reduced controller workload;

b) Reduction in the number of read-back/hear-back errors during coordination;

c) Reduction in the number of gross navigation errors and large height deviations caused by errors in the “controller-to-controller” coordination loop;

d) Gradual replacement of the ATS speech service as main coordination tool.

1.1.3. AIDC permits the exchange of information between ATS units in support of critical ATC functions. This includes the reporting of flights approaching a border flight information region (FIR), coordination of border crossing conditions, and transfer of control.

1.1.4. The AIDC provides interoperability between automated systems, enabling the exchange of data between ATSUs that are harmonised to a common standard. AIDC supports reporting, coordination and transfer of communications and control functions between these ATSUs. The capacity provided by the AIDC is compatible with a greater flexibility in separation minima applied in the adjacent airspace. The AIDC promotes seamless transfer of aircraft between the participating ATSUs.

1.1.5. AIDC defines the messages related to the three coordination phases as perceived by an ATSU.

a) *reporting phase*, in which the path of the aircraft and any change may be broadcast to an ATSU from the current ATSU prior to coordination;

b*) coordination phase*, in which the path of the aircraft is coordinated between two or more ATSUs when the flight is approaching a common border; and

c) *transfer phase*, in which communications and executive control are transferred from one ATSU to another.

1.2 Capacity and growth

1.2.1 Before implementing this interface between two automated centres, an analysis will be done of traffic expected between the centres. Also, the proposed communication links will be verified to make sure they meet the requirements for this purpose. Traffic estimates must take into account expected, current and future traffic levels.

1.2.2 Furthermore, the strategies developed by the SAM Region for the integration of automated ATM systems based on a safe, gradual, evolutionary and interoperable vision must be adopted. This will facilitate the exchange of information and collaborative decision-making amongst all the components of the ATM system, resulting in transparent, flexible, optimum, and dynamic airspace management.

CHAPTER II

2. TECHNICAL ASPECTS FOR THE IMPLEMENTATION OF AIDC BETWEEN ADJACENT AUTOMATED SYSTEMS

2.1. Introduction

2.1.1. When referring to AIDC-related communications, it should be noted that AIDC is an ATN application used for the exchange of ATS information between two units that have automated centres that support its implementation.

2.1.2. AIDC allows for the exchange of ATS information about active flights, with respect to flight notification, coordination, transfer of control, surveillance data and free text data.

2.1.3. When talking about this automated exchange, we are basically referring to ATS interfacility data communication (AIDC), as defined by ICAO.

2.1.4. Although technical provisions have been defined in various documents cited in this document, the current scenario in the SAM Region calls for an AIDC conceived in function of the means of telecommunication and facilities available in the States.

2.1.5. At present, the SAM Region has different systems and a multiservice platform (REDDIG) that are optimal and adequate. Consequently, the Region must work on three relevant elements: the concrete use of the AMHS system, the incorporation of automated systems that support AIDC, and a multiservice platform like REDDIG (the future REDDIG II) based on IP MPLS.

2.1.6. Beyond the various examples we can find—for example, the Asia/Pacific AIDC ICD--, this chapter will address the platforms and means that SAM States have or will have available in the short term. In this sense, emphasis will be placed on the AMHS and the ATN IP network for the implementation of AIDC.

2.1.7. Although this document is mainly aimed at becoming a practical guide, the technical provisions on AIDC defined in ICAO Doc 9880, Part II A, Ground-ground applications -AIDC (in replacement of ICAO Doc 9705/sub-volume III) must be taken into account.

2.1.8. It should be noted that the provisions on AIDC are also contained in ICAO Doc 4444, Chapter 11.

2.1.9. Although there are no communication protocols or physical path set for AIDC, different recommendations and practical references will be presented to facilitate implementation.

2.2. Communication considerations for the interconnection of automated centres

2.2.1. First of all, it should be noted that coordination can take place between the following ATSUs: ACC and ACC, ACC and APP, APP and APP, and APP and TWR.

2.2.2. It should be noted that, at present, the Plan for the Interconnection of Adjacent Automated Centres of the SAM Region, as relates to AIDC systems between the States, can be implemented in three ways:

1) AFTN: message format using the ITA-2 or IA-5 protocol, and using the header field for optional information (Vol. II, Annex 10, 4.4.15.2.2.6). It has a length of 69 characters. Implementation is recommended through REDDIG node ports. The caveat is that it only accepts the ASCII format.

The typical configuration of an AFTN channel is shown below.

AFTN Interface	Parameters
Type	Synchronous - Asynchronous
Data	AIDC
Format	ICAO
Message identification	ABI, CPL, CDN, FPL, EST, ACP, LAM, LRM, RJC, TOC, AOC
Message definition	Ref. Doc 4444
Data rate	1200 bps/ 9600bps/2400 bps
Physical connection	25 pin type “D”
Electrical characteristics	RS232c V24/V28
Data bits, parity, stop bits, protocol	8 bits, NP, 1 stp, IA-5 / ITA- 2

Table 1. AFTN channel configuration

2) Dedicated channel (point-to-point): involves the use of dedicated lines that meet safety and performance requirements. It is recommended that this be used through the REDDIG, and depending on the ports to be used.

3) AMHS: uses the REDDIG WAN network, whether over frame relay or an MPLS IP network, and applying the recommendations concerning the SAM REDDIG IP Plan. It is important to highlight the importance of interconnecting the MTAs between States as a precondition.

In the case of the AMHS, the required bandwidth is 4,8 Kbps and 14,4 Kbps (taking into account the additional bandwidth) (see Doc SAM ATN – Study on the implementation of a new digital network for the SAM Region (REDDIG II)).

2.2.3. The following graph illustrates a scenario with the different components of an AMHS architecture coexisting with AFTN.

Graph 1 - AFTN/AMHS scenario (source: Skysoft)

- UA: User agents (the customers, in this case, AIDC).
- MS: Message storage for handling message delivery and retrieval.
- MTA: Agent responsible for routing messages between MTAs, MSs and UAs.
- P7: Protocol used for retrieval from the MS (ITU-T X.413) (“push” type) by the UA
- P3: Delivery protocol (“pull” type)
- P1: Protocol for communicating and routing messages between MTAs (ITU-T X.411)
- DS: Directory server that communicates using X.500 protocols

2.2.4. Regarding the bandwidth required for the three aforementioned cases, document SAM ATN – Study on the implementation of a new digital network for the SAM Region (REDDIG II)), states the following:

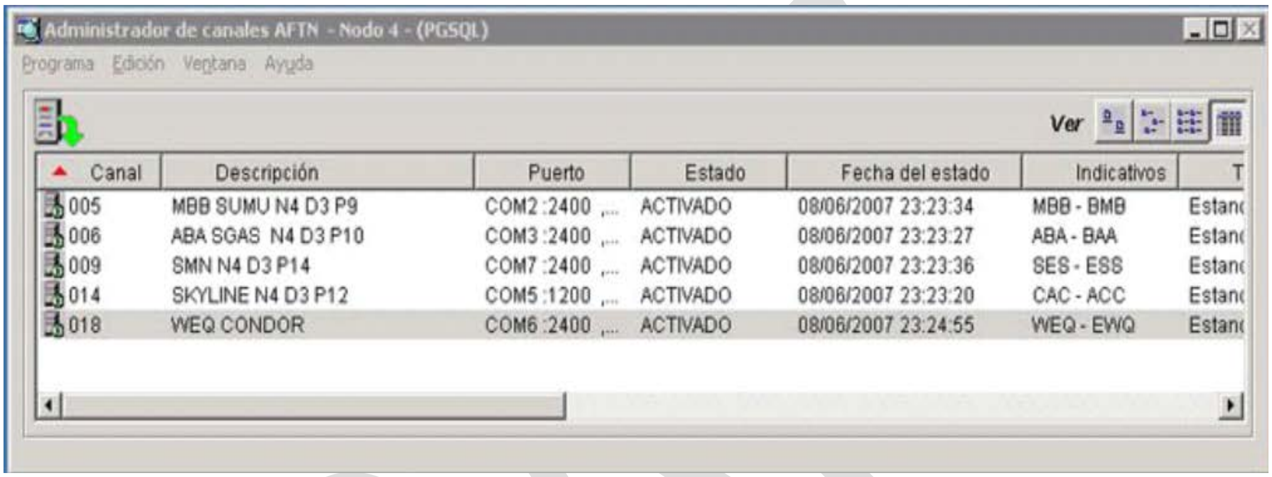
In the case of AFTN and AMHS, *“these are AFTN messages generated/received by automated systems, which travel over the respective AFTN or AMHS systems (or a combination of both). Accordingly, the increase in the amount of information will only result as an increase in the number of AFTN messages circulating through the ATN”*.

2.2.5. *“Since ATS traffic has historically accounted for only 15% of total AFTN traffic, assuming a 3-fold increase (300%) of ATS messages, this will only result in a 30% increase in AFTN traffic”*.

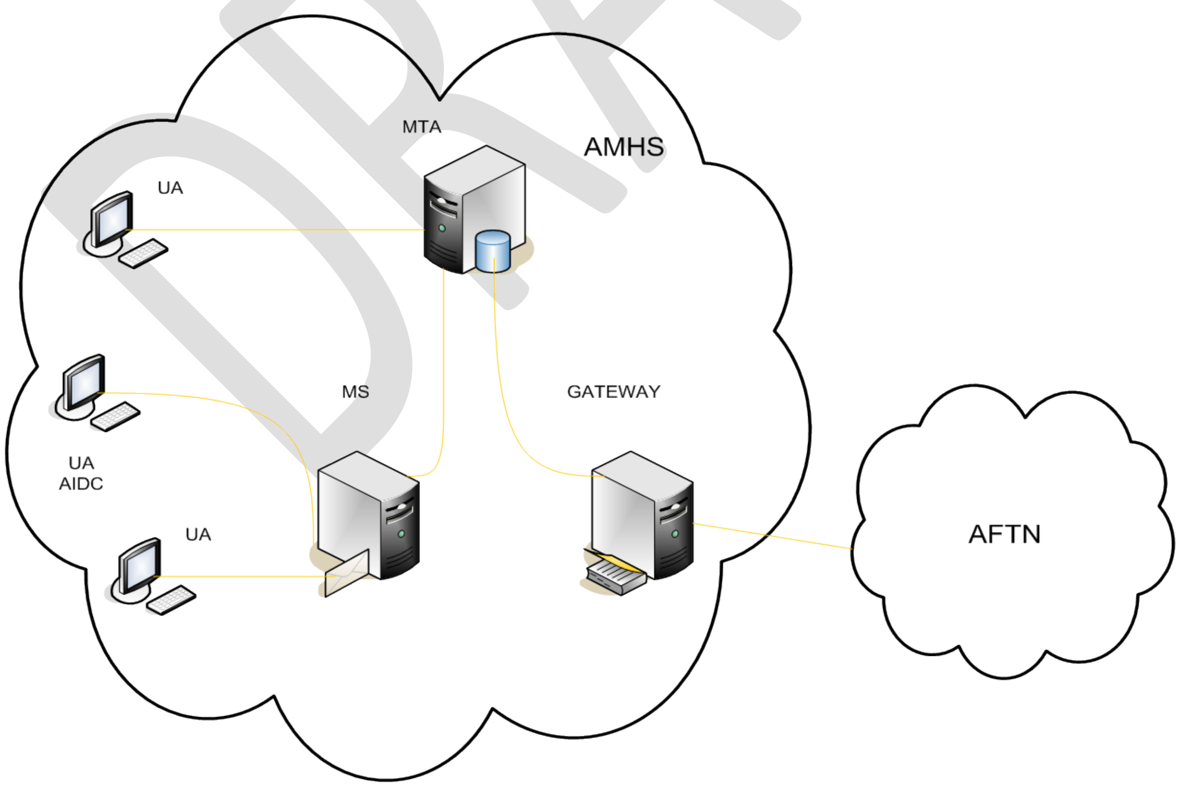
2.2.6. In the case of a dedicated link, each centre will send the information to the corresponding adjacent centre, *and the bandwidth will be increased in function of the number of control messages to be generated by each automated centre, which will obviously be a function of surrounding air traffic.*

2.2.7. This ICD mainly refers to the implementation of AIDC based on AMHS and AFTN systems.

2.2.8. AIDC messages will be exchanged through the AFTN and the AMHS. However, AFTN/AMHS gateways shall be used to allow the two systems to continue coexisting, both at present and in the future. Accordingly, these gateways convert AFTN messages to the AMHS format and *vice versa*.



Graph 2 – Channel display for a SAEZ gateway administrator



Graph 3 – Schematic of gateway function

2.2.9. It should be noted that in 2005, SAM States decided to start replacing their AFTN aeronautical messaging systems with AMHS messaging systems, which have been implemented over IP networks (version 4), especially for the interconnection of MTAs between States.

2.3. Phases to be taken into account for the implementation of AIDC between adjacent automated centres of different States

2.3.1. A practical guide on the steps to follow to ensure an effective implementation of AIDC for coordination between adjacent automated centres of different States should take into account the following aspects.

2.3.2. As already stated, this mainly refers to the use of the means already available or to be implemented in the short term in the States.

2.3.3. In conclusion, the following items must be taken into account:

1) Drafting of the memorandum of understanding between the States
2) Provision of connectivity between the AMHS server or AFTN CCAM or dedicated channel and the automated system
3) Establish the physical and logical connection between the States
4) Create the required AMHS or AFTN user accounts (mailbox)
5) Verify the user accounts
6) Incorporate user accounts into the automated systems that support AIDC
7) Establish a test protocol
8) Conduct pre-operational tests
9) Conduct operational tests
10) Establish and define definitive operating stages (letters of agreement)

2.4. Prepare the memorandum of understanding between the States

2.4.1. First, the States must sign a memorandum of understanding (bilateral agreement) clearly expressing the commitment of the parties to implement the interconnection of automated air traffic systems, especially for AIDC.

2.4.2. Basically, this document must contain the references on which the work will be based; the purpose; the operational, technical, administrative and financial aspects; and everything that the intervening States deem important to include in the document.

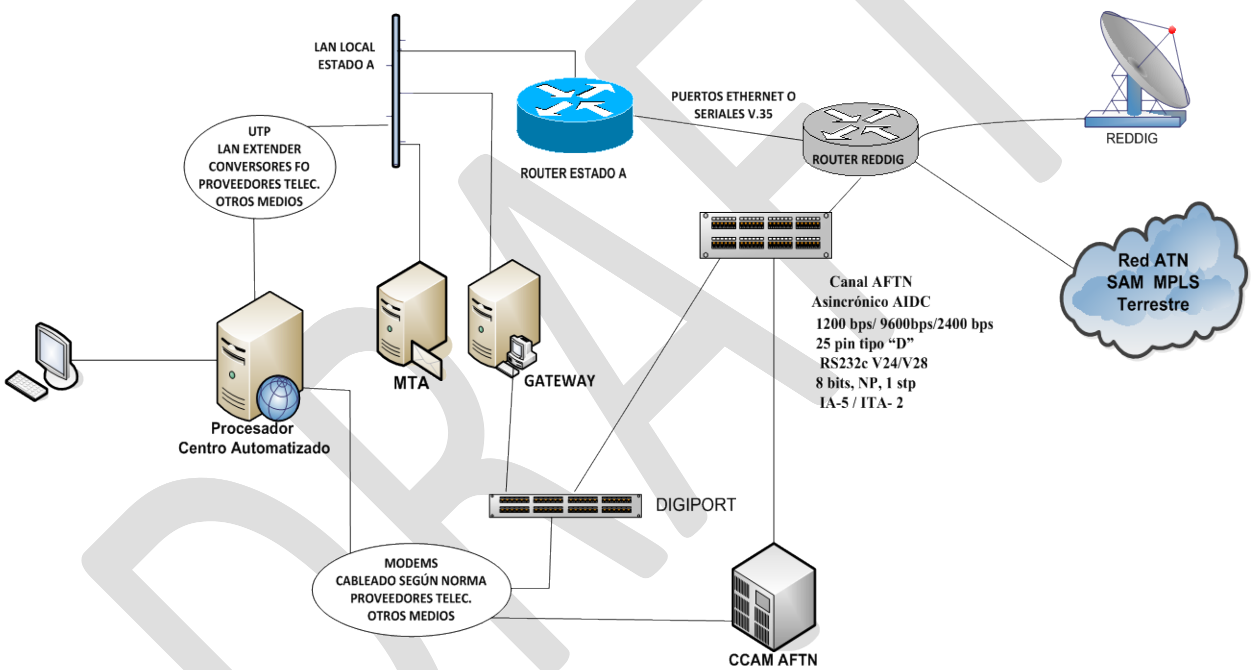
2.4.3. It is important to note that, for purposes of the implementation, the States must identify the focal points (coordinators) to be responsible for coordinating the respective work teams to be established as required (that is, technical, operational or technical-operational teams).

2.4.4. These focal points (coordinators) shall be designated by an Interconnection Management Committee, which, in turn, will be composed of a Coordinator, a Technical Group, and an Operational Group.

2.4.5. The SAM Implementation Group (SAM/IG) approved the use of a model Memorandum of Understanding (MoU) for the interconnection of automated systems (fourth workshop/meeting of the SAM Implementation Group (SAM/IG/4) – Regional Project RLA/06/901, Lima, 19-23 October 2009). The MoU can be found in the SAM/IG/4 meeting report, Agenda Item 7, Appendix B, at the ICAO SAM Regional Office Website.

2.5. Provision of connectivity between an AMHS server or AFTN CCAM or dedicated channel and the automated system

2.5.1. The first thing that must be available in each State is the connectivity between the AMHS server, or AFTN CCAM, or the dedicated channel (which is supposedly integrated to its users), whether through a TCP/IP platform, synchronous/asynchronous port, or dedicated channel, respectively. Within this framework, it is understood that the connection between the telecommunication node (that physically hosts the connection that allows linkage with the other State) and the automated system will be achieved through the IP network, or local gateway, or specific cabling, as applicable.

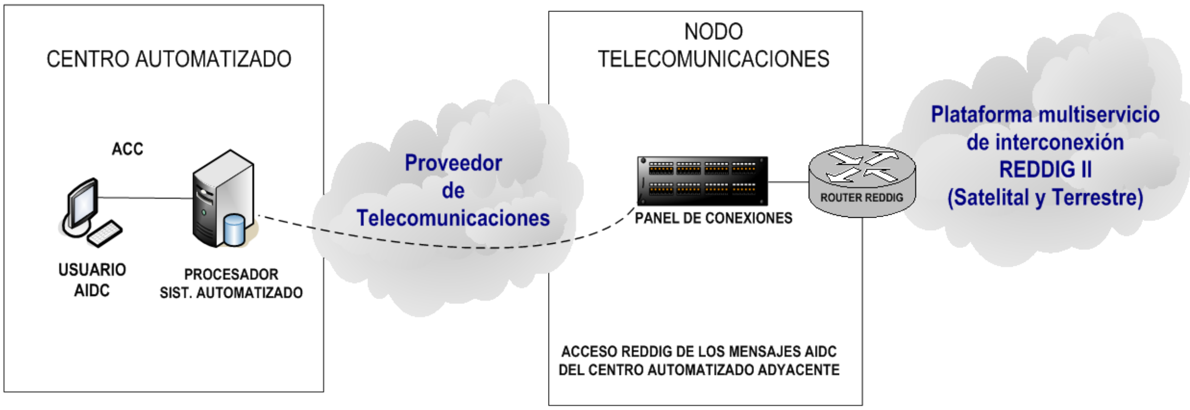


Graph 4 – Possible last-mile connectivity scenarios

2.5.2. In this regard, the aforementioned would seem of minor significance, since the respective telecommunication node or server is generally close to the automated centre. But this aspect acquires significance when considering those cases in which structured cabling and physical interface standards (distance factor, cable characteristics, connector, protocol, etc.) demand technical solutions that may require economic resources. For example: State A has a local IP network at the same location as the REDDIG telecommunication node, and the automated system is located in B, which is in another city or at a distance greater than 100 meters.

2.5.3. In this example, this is an important factor to bear in mind due to technical-administrative timings and the budgetary element involved. This is an important aspect since it could affect implementation times and thus the bilateral agreement.

2.5.4. We know that an automated centre receives the flight plans and it is to be assumed that, given the above scenario, the aforementioned would be no major problem. However, it should be taken into account, especially when talking about point-to-point connections.



Graph 5 – Illustration of the case in which the AIDC message telecommunication access node is far from the automated centre

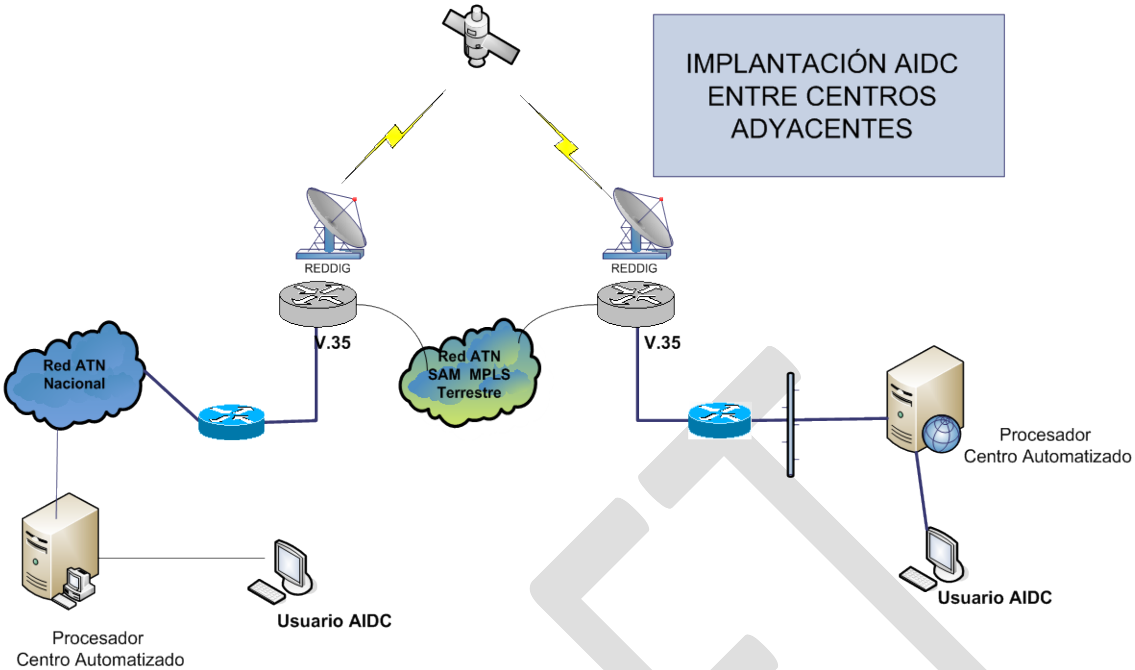
2.6. **Establish physical and logical connectivity between States**

2.6.1. Once local connectivity is achieved, physical and logical connectivity between the States must be established.

2.6.2. For the completion of this phase, the tools and means available in the SAM Region to implement AIDC between the States are presented below.

2.6.3. *REDDIG. Regional multi-service platform*

2.6.4. It should be first noted that the REDDIG is a multi-service platform on which the physical and logical connectivity between States for AIDC must be established. Furthermore, this network currently permits both AFTN and AMHS traffic.



Graph 6 – Integration of AIDC users of adjacent centres

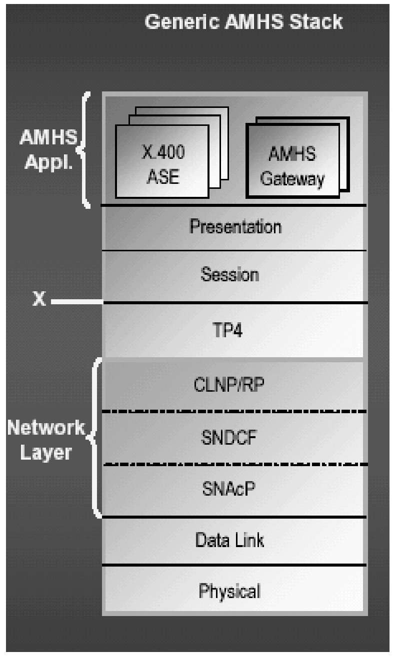
2.6.5. In this regard, the definition of connectivity adopted in the Memorandum of Understanding must be taken into account.

2.6.6. Although already mentioned, some considerations and elements to be taken into account when establishing the link between States are iterated below.

2.6.7. For each case, it shall be noted that AFTN channels are normally configured at 2400 bps or 9600bps, 8 bits, NP, 1stp, IA-5, synchronous/asynchronous, RS 232c V24/V28, physical connection: 25-pin, type 'D'.

2.6.8. For an AMHS system, the following elements are taken into account: MTA, MS, DS (X.500), gateway to support AFTN channels, CAAS addressing, **message exchange protocols: MTA-MTA: P1** / UA-MS: P7, users – machines (Flight Data Processor – AU), users – humans (terminals - UA), Mailbox: 2100. The required bandwidth will be 4,8 Kbps and 14,4 Kbps (considering the additional bandwidth) (see graph on page 9).

2.6.9. Likewise, in the case of the AMHS, the reference used is the OSI model, which defines the elements to be taken into account, depending on the layer. For dedicated links, based on the experience of the Region, ports of characteristics similar to those of AFTN channels are used. In this sense, note should be taken of that mentioned in paragraphs 2.2.2, 2.2.3, 2.2.4 and 2.2.5.



Graph 7 – OSI model reference

2.7. **Possible scenarios**

2.7.1. Currently, most SAM States have incorporated AMHS. In reality however not all States have interconnected their MTAs. Therefore, those States that have AMHS also have an associated gateway that does the conversion from the AMHS "world" to the AFTN "world" and *vice versa.* This is an important issue to be taken into account during AIDC implementation.

2.7.2. *Connectivity through asynchronous ports.* This case may be applied both to a dedicated link or to an AFTN application.

2.7.3. Paragraph 2.6.6 and Doc 9880 must be taken into account.

2.7.4. *Connectivity through an IP network.* Currently, there is a REDDIG IPv4 Addressing Plan in the SAM Region, **Appendices A** and **B**, which establishes 8190 IP addresses assigned to each State. It is understood that this availability of addresses would be enough to meet current needs.

2.7.5. Furthermore, the SAM REDDIG IPv4 addressing plan gives flexibility to each State/Territory in the design of its ATN networks and in local implementation of aeronautical applications over IP networks. Likewise, this scheme takes into account future requirements based on address availability.

2.7.6. In order to establish this type of link between States, some physical and logical aspects must be considered.

a. Follow the REDDIG IPv4 addressing scheme set for the Region.
b. Identify the physical port to be used for connecting to the networking equipment of the State network (router)
c. Define, if applicable, the V.35 DCE/DTE interface or protocol

d. Set the configuration parameters for networking equipment:
   * Type of encapsulation
   * DLCI for frame relay, or port priority (QoS) for MPLS,
   * Type of LMI protocol for frame relay,
   * REDDIG WAN IP address (see SAM REDDIG IPv4 addressing plan, Annex C, graph 9).
   * REDDIG LAN IP address (see SAM REDDIG IPv4 addressing plan, Annex B, graph 9)

e. States that have had local addressing prior to the implementation of the SAM REDDIG IPv4 addressing plan or that have not taken it into account shall use NAT (network address translation) or some other mechanism to adapt the national IP network to the regional IP network. See graph 8.

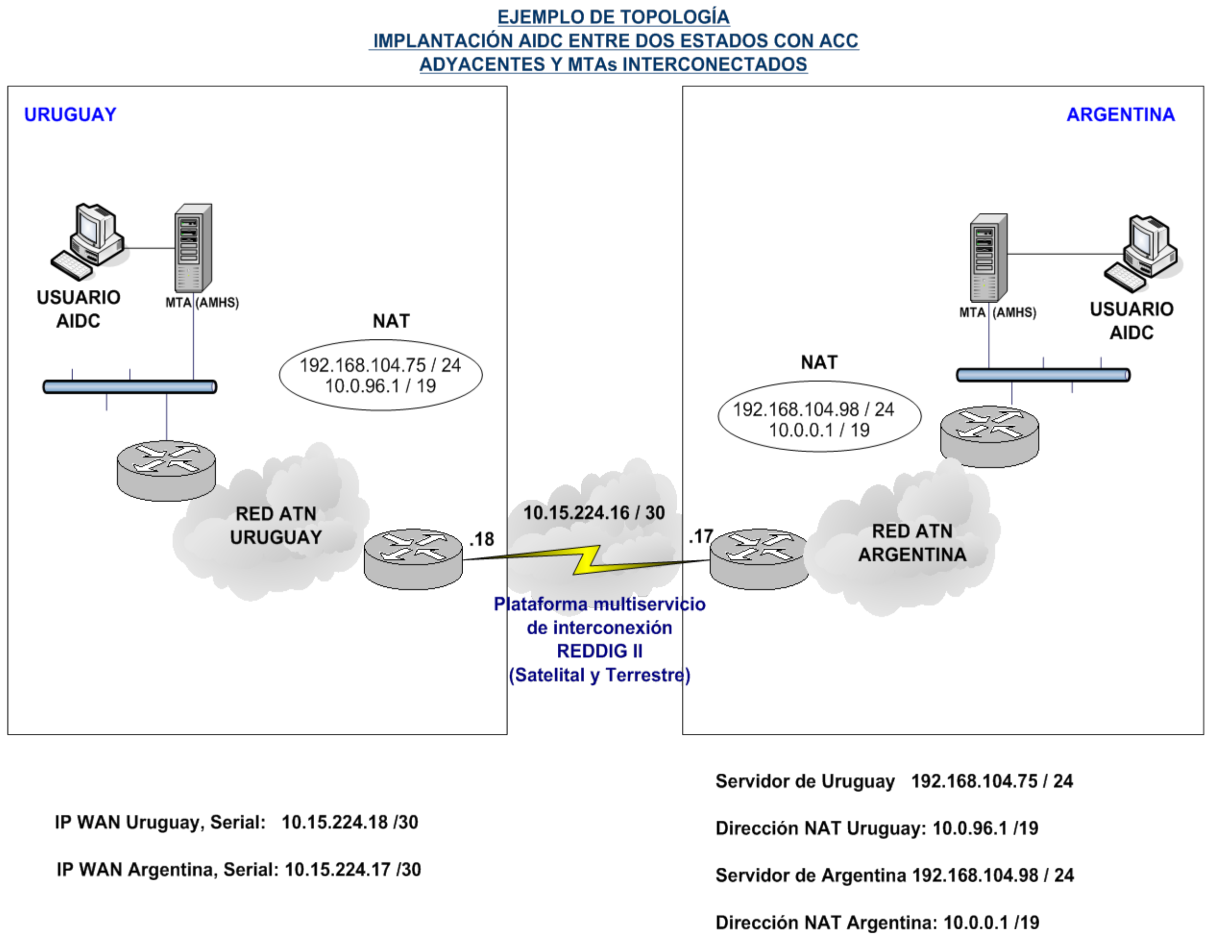
```
AMHS-RT-EZE-03#sh ip nat translations
Pro Inside global      Inside local        Outside local       Outside global
--- ---                ---                 192.168.48.100      10.0.0.1
--- ---                ---                 192.168.104.34      10.0.0.10
--- ---                ---                 192.168.104.233     10.0.96.10
tcp 10.0.0.1:102       192.168.48.100:102  10.0.64.2:12341     10.0.64.2:12341
tcp 10.0.0.1:102       192.168.48.100:102  10.0.64.2:16023     10.0.64.2:16023
tcp 10.0.0.1:102       192.168.48.100:102  10.0.64.2:38573     10.0.64.2:38573
tcp 10.0.0.1:102       192.168.48.100:102  10.0.64.2:63718     10.0.64.2:63718
tcp 10.0.0.1:102       192.168.48.100:102  10.0.64.2:64317     10.0.64.2:64317
--- 10.0.0.1           192.168.48.100      ---                 ---
udp 10.0.0.10:4001     192.168.104.34:4001 10.0.113.99:4001    10.0.113.99:4001
udp 10.0.0.10:4001     192.168.104.34:4001 10.0.114.99:4001    10.0.114.99:4001
--- 10.0.0.10          192.168.104.34      ---                 ---
--- 10.0.96.10         192.168.104.233     ---                 ---
```

Graph 8 – Verification of address translation

2.7.7. In order to understand address translation between two States, the previous graph shows that IP 10.0.0.1 is consistent with the SAM REDDIG IPv4 plan, and is associated to IP 192.168.48.100, which is an MTA of Argentina (local IP address of the State ATN), while 10.0.64.2, also consistent with the SAM REDDIG IPv4 plan, is the IP assigned to an MTA of Brazil.

2.7.8. Basically, in order to comply with the above, each State must have the networking equipment (router) that will be connected, on the one hand, to the State LAN and, on the other, to the REDDIG networking equipment (FRAD or router) through a serial port or Ethernet. In this case, the SAM REDDIG IPv4 plan defines the REDDIG WAN and LAN addresses.

2.7.9. The connection scheme described above is shown below.



Graph 9 – Example of AIDC topology using the SAM REDDIG IPv4

2.7.10. After verifying the connection between the end networking units and the connectivity with the respective local networks, the following phases shall be implemented.

2.7.11. Taking into account the SAM REDDIG IPv4 addressing plan for REDDIG LAN networks (see Appendix A), each State may use the addresses and the addressing scheme of its choice. Nevertheless, a redistribution of network segments is proposed in **Appendix C**.

2.7.12. The purpose of this recommendation is to be able to specify what network segments will be assigned to certain services. It basically means dividing the REDDIG LAN networks of each State into VLANs. But these VLANs must have the same structure in all States.

2.7.13. This recommendation is not only intended for application in AIDC but also in all current and future services to be exchanged between SAM States. It also permits the establishment of a pre-established order that will contribute to an orderly implementation of services (see Annex D to this document).

2.7.14. It is also advisable that:

1) Network addresses are assigned in continuous blocks.

2) Address blocks are distributed in hierarchical order to enable routing scalability.

3) Sub-network configuration is made possible in order to take maximum advantage of each assigned network (subnetting).

4) Super-network configuration is made possible in order to take maximum advantage of each assigned network (supernetting)

5) The quality of service in an MPLS (REDDIG II) environment is specified.

2.7.15. The only assigned addresses that are known to the rest of the States will be those of the interfaces of the communication equipment used at the *interconnection boundaries* between the internal and external networks of each State.

2.7.16. For the interconnection between their bordering equipment, the States will agree on the routing protocol to be used, unless REDDIG II implementation requires otherwise.

2.7.17. Each State shall ensure routing through its network to the internal address(es) of the application servers it uses *vis-a-vis* other States.

2.7.18. The Regional Office, by virtue of the corresponding institutional arrangements, will coordinate the implementation of the selected *regional routing*.

2.8. **Create the required AMHS or AFTN user accounts (mailbox)**

2.8.1. At this point, the user accounts that will operate with AIDC for the interconnection between automated centres must be defined. In this regard, it should be noted that the eight-letter designator would not be affected whether AMHS or AFTN systems are used.

2.8.2. This is relevant for AMHS because the address of the AMHS server must be associated to a REDDIG IPv4 address of the SAM addressing plan. For example: the AIDC user of State A, in addition to its eight-letter address, will be associated to an IP address of the national ATN. When the AIDC user of State A sends an AIDC message to an AIDC user of adjacent State B, the AMHS server will interpret that it is a message for State B. At this point, two things may happen:

1) If both States have an AMHS system and the respective MTAs are interconnected, traffic shall be routed through an IP address specified in the SAM REDDIG IPv4 plan and associated to the servers of the States.

2) If neither State has AMHS, or one does and the other one does not, or both have it but their MTAs are not interconnected, traffic will be routed to the gateway so that it is transferred to the AFTN world; or will use the assigned AFTN port directly to the destination State. In the case of the AFTN, the channel must be configured in the gateway or AFTN system (data rate, type of channel, standard, type of interface, mode, etc.).

2.8.3. According to the experience in Argentina, it is necessary to have at least two user accounts: one will be set for transmitting AIDC messages and the other for receiving AIDC messages.

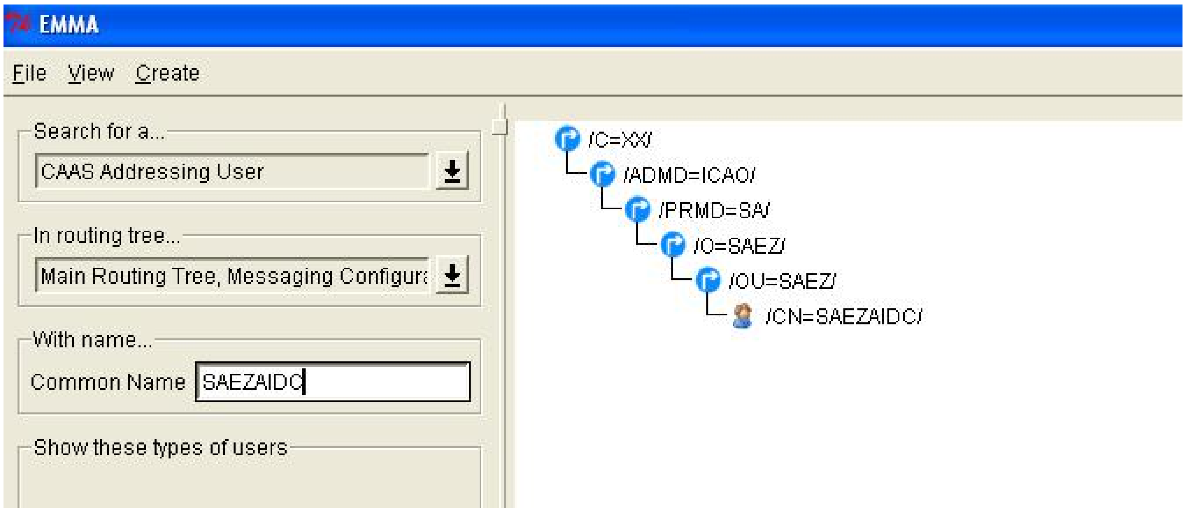
2.8.4. In order to standardise user accounts, this document proposes that the last four letters of the assigned address should be: AIDC for transmission and CADI for reception. In this manner, all the personnel of the States of the Region will readily identify that the message belongs to AIDC.

2.8.5. Example:

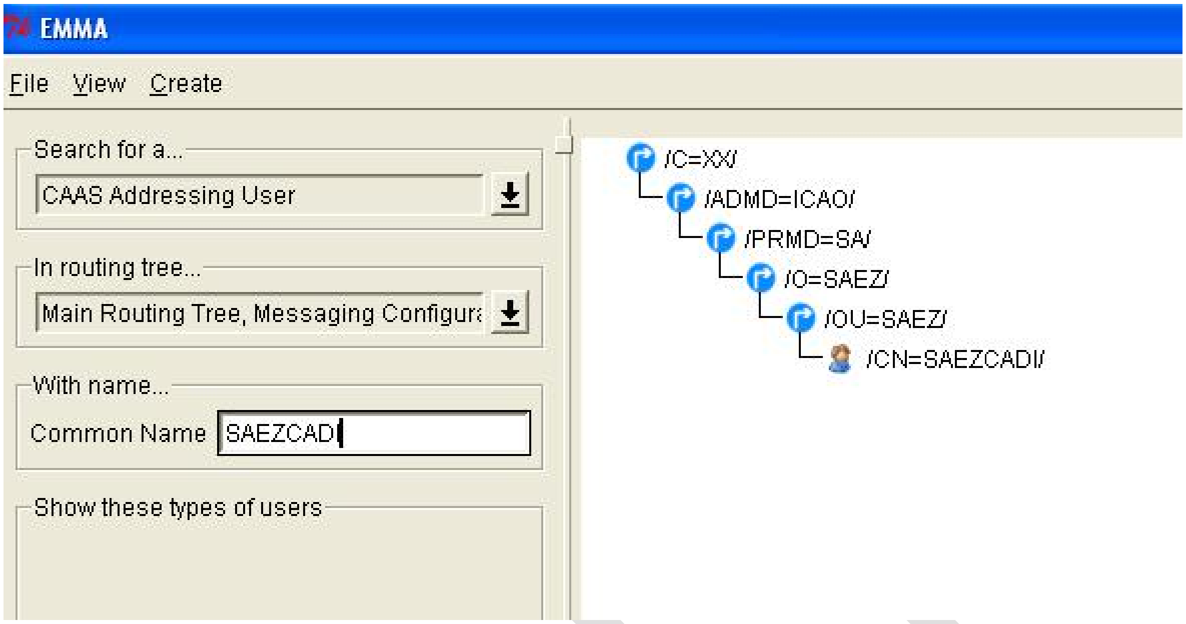
"Assuming the automated centres of Uruguay and Argentina are interconnected, the following addresses will be defined":

	AFTN/AMHS address for transmission	AFTN/AMHS address for reception
Uruguay	SUMU**AIDC**	SUMU**CADI**
Argentina	SAEZ**AIDC**	SAEZ**CADI**

Table 2. AFTN/AMHS addresses



Graph 10 – Configuration of the AIDC account in the AMHS system



Graph 11 – Configuration of the CADI account in the AMHS system

2.9. **Verify the user accounts**

2.9.1. Although the operational verification of user accounts is simple and basic, it is a vital step prior to implementation, where members of the Technical Group and the Operational Group of the Interconnection Management Committee will test the delivery and reception of AIDC messages between AIDC accounts users.

2.9.2. To this end, test AFTN or AMHS terminals must be available and configured as if they were end users (automated systems). See Doc 9880 and Doc 4444.

2.9.3. For message transmission, the AIDC application requires that:

a) messages be generated and sent in the required time sequence; and

b) messages be delivered in the order they are sent.

2.10. **Incorporate user accounts to the automated systems that support AIDC**

2.10.1. Once the proper operation of user accounts has been verified, the next step is to coordinate with the technical-operational personnel--which should be part of the Interconnection Management Committee--for their incorporation into the automated systems.

2.10.2. It is recommended that this task be fulfilled preferably in a simulator, if available. More details in this regard are provided in Chapter III of this document, which deals with operational aspects.

2.11. **Establish a test protocol**

2.11.1 Once user accounts have been incorporated into the automated system, the Interconnection Management Committee, which is made up by personnel from both States, will establish a test protocol based on that stated below.

2.11.2 This protocol must cover all aspects related to AIDC operation. In this sense, Annex A contains a general model that must be enriched with the experience gained from various implementations between States.

2.12. Conduct pre-operational tests

2.12.1. The test protocol will permit the conduction of pre-operational tests. These tests must take place within a safe context to prevent these AIDC messages from entering the operational system that is operating at that moment.

2.12.2. Consideration should also be given to the requirement of informing all stakeholders, as necessary, about the conduction of these tests.

2.12.3. This part of the document is further explained in Chapter III.

2.13. Conduct operational tests

2.13.1. The direct participation of controllers is required for the conduction of operational tests. In this regard, it should be noted that for satisfactory conduction of these tests, controllers must work with the AIDC for a period of at least four (4) hours in two (2) days. These parameters shall be defined based on experience and minimum time required.

2.14. Establish and define the definitive operating stages

2.14.1. Although Chapter III will provide more details in this respect, it must be noted outright that stages need to be defined. Basically:

a) in the first stage, the AIDC will support speech coordination between centres.

b) in the second stage, the opposite will occur, where speech communication will support the AIDC system.

2.15. Associated automation functionality

2.15.1. Each ATS service provider must be required to have the necessary support in each automation system that is implemented or to be implemented in order to be initially capable of:

- Error verification: check all incoming messages for the right format and logical consistency
- Making sure that only messages from authorised senders are accepted and processed
- When necessary, alerting the responsible controller about the flight data received.
- Making sure that the appropriate personnel can configure the logical-automatic response time of a message initiated at the other control unit.

2.16. Solutions or recommendations in case of failure or recovery

2.16.1. Automation systems may have different mechanisms for avoiding major failures and for error recovery. Basically, each participating system shall have the following characteristics:

- If the recovery process preserves the current message number at the time of the occurrence, in the sequence established between each intervening system, the notification is not required.
- If the recovery process requires the resetting of the sequence number to 000, a means must be established to notify the receiver unit that message numbers have been reinitiated. This may be established as a procedure agreed between the parties instead of being automated.

2.16.2. Once a LAM is received, if a recovery process takes place following an occurrence, the CPL is not sent automatically, so any CPL for which a LAM had been received must be sent again. This is relevant if the system was able to recover information on the status of coordinated flight plans that have been coordinated and has no need to restore message sequence numbers.

2.17. **Security considerations**

2.17.1. **Privacy**

2.17.1.1. The ICD does not define mechanisms to ensure privacy. It may be assumed that data sent through this interface can be seen by undesired third parties, either by intercepting messages or through disclosure at the receiving centre.

2.17.1.2. All communications that require privacy must be identified, and communications and procedures properly defined. In this sense, it is recommended that mechanisms be used for preserving the confidentiality of information (*e.g.*, firewalls, private networks, trained technical and administrative personnel, etc.). Thus the critical importance of using the REDDIG as part of a private network.

2.17.1.3. It is also recommended that, during coordination between the States, the security policy to be implemented be taken into account as a determining factor. Even more so if the trend is to use IP networks, regardless of the platform.

2.17.1.4. In order to avoid threats and vulnerabilities, these security policies should be aimed at:

- Protecting confidentiality
- Preserving integrity
- Ensuring availability

2.17.1.5. Security risks cannot be completed eliminated or prevented; however, they can be minimised through effective risk management and assessment. Although the future ATN network supported by the REDDIG II is not available for the non-aeronautical world, it is open to the aeronautical world.

2.17.1.6. ATN network users expect security measures to ensure:

- That users will only be able to carry out authorised tasks.
- That users will only be able to obtain authorised information.
- That users will not be able to damage the data, applications or the operating environment of a system.
- A system that can track user actions and the network resources to which these actions have access.

2.17.2. The "safety policy" is key to the implementation not only of AIDC but also of all the services in the Region. Consequently, special attention should be paid to the "Guidance on Safety for the Implementation of IP Networks", Project D1, SAM ATN Architecture, April 2013.

2.17.3. **Authentication**

2.17.3.1. Each system must verify that messages received are from the source stated in Field 03, which identifies the message type designator, message number, and reference data (see Doc 4444).

2.17.4. **Access control**

2.17.4.1. Each system participating in the interface will implement access controls to ensure that the source of the message is authorised to send a given type of message and that it has the right authority over the flight in question.

2.18. **Performance considerations**

2.18.1. Communication systems. Requirements and parameters

2.18.2. In addition to the requirements specified in this document, all data link applications require that:

a) the probability of not receiving a message be 10^{-6} or less;

b) the probability that a message not received is not be notified to the sender be 10^{-9} or less; and

c) the probability that a message is erroneously routed be 10^{-7} or less.

2.18.3. The figures in Table 3 reflect the various performance levels that may be selected for the provision of data link services. Depending on the level of service to be provided, a State may define its performance requirements based on factors such as separation minima applied, traffic density, or traffic flow.

Application	**Availability (%)**	**Integrity**	**Reliability (%)**	**Continuity (%)**
DLCI	99.9	10^{-6}	99.9	99.9
ADS	99.996	10^{-7}	99.996	99.996
CPDLC	99.9	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

Table 3. Performance requirements

2.18.4. Except under catastrophic circumstances, and based on the previous parameters, there may only be one end-to-end interruption that shall not exceed 30 seconds. (End-to-end availability can be achieved through the provision of alternate communication routes wherever possible. In this sense, REDDIG II contemplates this scenario.)

2.18.5. For flight planning messages, controllers need a failed message transmission indication within 60 seconds of the message being sent. Therefore, the response time from the moment a message is sent until a LAM (or LRM) is received shall be less than 60 seconds at least 99% of the time under normal operating conditions. However, this can vary depending on the requirements of each centre. This may be modified following an analysis to ensure service efficiency.

2.18.6. Consequently, the response time from the moment a message is sent until a LAM (or LRM) is received shall be less than 60 seconds at least 99% of the time under normal operating conditions. A fast response time is desirable and will result in more efficient operations.

2.19. Availability and reliability

2.19.1. The software and hardware resources required for providing an interface service to users in the SAM Region must be developed in such a way that reliability is inherent to interface availability, which should be at least the same as that for end-to-en systems (for example, 99,7% availability for the systems at each end, which operate with 99,7% reliability).

2.20. The technical considerations contained in this document for the implementation of AIDC between adjacent automated centres are supplemented with current appendices, annexes, guides, and documents.

CHAPTER III

3. OPERATIONAL ASPECTS FOR THE IMPLEMENTATION OF AIDC BETWEEN ADJACENT AUTOMATED SYSTEMS

3.1. Introduction

3.1.1. This application of data communications between air traffic control units is not intended to fully replace voice communications. Initially, it will supplement traditional (voice) communications and will gradually become the main coordination channel, supplemented by speech communication.

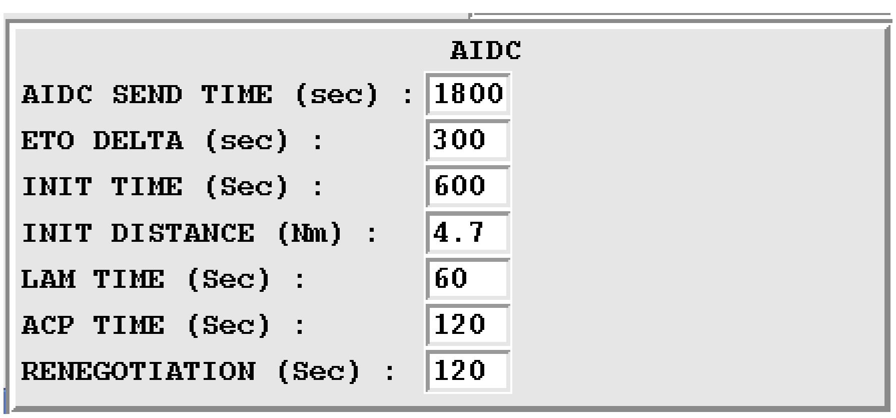
3.1.2. The notification, coordination and transfer stages will continue to be the same as those described in ICAO Doc 4444 in Chapter 10, with the difference that, when using an AIDC application, the intervention of the operator will be minimal.

3.1.3. AIDC messages will have the same format and content as those normally used, as shown in ICAO Doc 4444, Chapter 11.

3.2. Letter of Operational Agreement

3.2.1. Prior to AIDC implementation, a new letter of agreement between ATC units will be drafted, taking into account aspects concerning how much time in advance will messages be transmitted from one unit to the other.

3.2.2. This agreement between the parties will result in the configuration of each automated system according to the following example:



Graph 12. AIDC configuration

- *AIDC SEND TIME (sec):* Time before arrival to the ABI message delivery coordination fix.
- *ETO DELTA (sec):* Difference in the estimated time of flight over the coordination fix that triggers the delivery of a new ABI message.
- *INIT TIME (sec):* Time before arrival to the coordination fix, which generates an EST message.
- *INIT DISTANCE (Nm):* Distance to the coordination fix, which generates an EST message.
- *LAM TIME (sec):* Waiting time of the LAM message.

- *ACP TIME (sec):* Waiting time of ACP message.
- *RENEGOTIATION (sec):* Waiting time to renegotiate coordination.

3.3. **Minimum AIC message set**

Category	Message	Name	Description
Pre-departure coordination of flights	FPL	Filed flight plan	Flight plan, as filed before the ATS unit.
	ABI	Notification	Notification messages will be sent in advance to ATS units.
Coordination of active flights	CPL	Current flight plan	The flight plan, including changes resulting from clearances.
	EST	Estimate	Time expected to cross the point of transfer or boundary point.
	CDN	Coordination	Proposal of amendment to coordination conditions.
	ACP	Acceptance	Acceptance of proposed coordination or amendment.
	RJC	Rejection	Coordination rejected
Transfer of control	TOC	Transfer	The controller of the transferring unit has instructed the flight to establish communication with the controller of the accepting unit.
	AOC	Acceptance of transfer	The flight has established communication with the accepting controller
Logical	LAM	Logical acknowledgment	Acceptance of application.
	LRM	Logical rejection	Rejection of application.

Table 4. ATC message set

3.3.1. **Appendix D** to this document shows the format of messages in the minimum set.

3.4. **AIDC procedures**

3.4.1. **Notification stage**

3.4.1.1. The FPL enters the system and is in pre-notification state.

(FPL-SAEZ/SACO-ARG1502-IS-A320/M-SW/C-SAEZ1235-N0450F320 ATOVO3B ATOVO UW5 CBA-SACF0055-EET/SACF0037)

This is a flight plan for a flight from the International Airport of Ezeiza, in Buenos Aires to the International Airport of Cordoba, in Cordoba, with a proposed time of departure of 1235 UTC.

3.4.1.2. A predetermined time before the estimated time of passage over the coordination fix, the system sends an ABI. The FPL changes to the notified State.

(ABI-ARG1502/A1701-SAEZ-UBREL/1330F320-SACO-8/IS-9/A320/M-10/SW/C)

This is the ABI message that the automated system of Ezeiza sends to indicate to the Cordoba automated system that ARG1502 will be in the UBREL position at 1330.

3.4.1.3. The system receives a LAM, confirming that the system of the adjacent centre has a flight plan.

(LAM)

3.4.1.4. During the notification phase, the system sends an ABI message with each notification about the FPL, receiving a LAM for each ABI sent.

3.4.2. **Coordination stage**

3.4.2.1. A given time before the estimated time of passage over the point of notification or at a given distance from it, the system sends an EST message, and the FPL changes to the coordination state.

(EST-ARG1502/A1701-SAEZ-UBREL/1345F320-SACO)

This is an EST message sent by the Ezeiza system to the Cordoba system, notifying that the aircraft is in the air and estimated to arrive at the coordination fix at 1345.

3.4.2.2. The system receives a LAM acknowledging receipt of the EST message.

(LAM)

3.4.2.3. The operator of the receiving control centre must accept (ACP) or negotiate (CDN) the coordination.

3.4.2.4. If the operator of the receiving control centre accepts the coordination, the FPL changes to the Coordinated state.

(ACP-ARG1502-SAEZ-SACO)

3.4.2.5. The system receives an ACP and sends a LAM.

(LAM)

3.4.3. **Negotiation stage**

3.4.3.1. If the operator of the receiving control centre renegotiates the coordination (CDN), the FPL changes to the Renegotiation state.

(CDN-ARG1502-SAEZ-SACO-14/UBREL/0450F340)

This is a CDN message sent by the operator in Córdoba requesting that flight ARG1502 be transferred with FL340.

3.4.3.2. The system receives a CDN and sends a LAM.

(LAM)

3.4.3.3. The operator of the originating control centre must accept (ACP) or negotiate (CDN) the coordination.

3.4.3.4. If the operator of the originating control centre accepts the coordination (ACP), the FPL changes to the Coordinated state.

(ACP-ARG1502-SAEZ-SACO)

3.4.3.5. The system sends an ACP and receives a LAM.

(LAM)

3.4.3.6. If the operator of the originating control centre renegotiates the coordination (CDN), the FPL changes to the Renegotiation state.

(CDN-ARG1502-SAEZ-SACO-14/UBREL/0450F300)

This is a CDN message sent by the operator in Ezeiza requesting the operator in Córdoba to clear FL300 for ARG1502.

3.4.3.7. The system sends a CDN and receives a LAM.

(LAM)

3.4.4. **Transfer stage**

3.4.4.1. When the aircraft is close to the coordination FIX, at a distance or under the conditions established in the letter of agreement between the units, the operator of the originating control centre must send a transfer message (TOC). The FPL changes to the Transferring state.

(TOC-ARG1502/A1701-SAEZ-SACO)

3.4.4.2. The system sends a TOC and receives a LAM.

(LAM)

3.4.4.3. The operator of the receiving control centre must accept the transfer with an acceptance of transfer of control message (AOC). The FPL changes to a Transferred state.

(AOC-ARG1502/A1701-SAEZ-SACO)

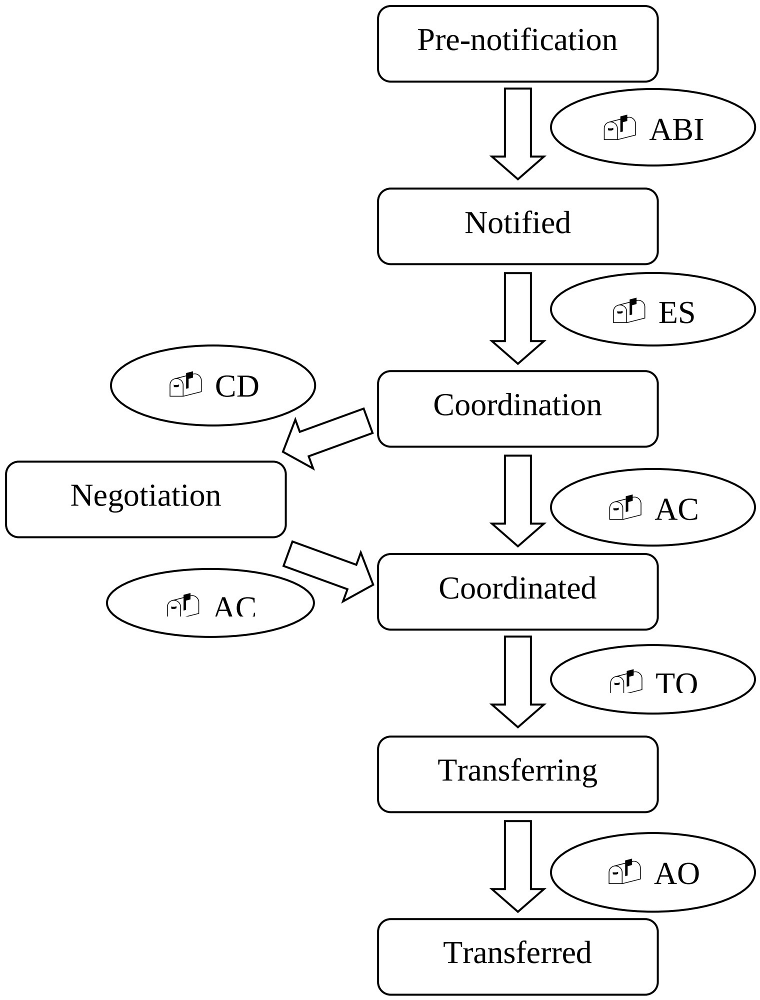
3.4.4.4. The system receives an AOC and sends a LAM.

(LAM)

3.4.4.5. Negotiations can be conducted after the transfer of a flight.

3.4.4.6. Note that, under normal coordination conditions, the function of the operator of the sector where the flight originates is limited to just observing the status of coordination in the flight table. In turn, the operator of the unit that will receive the flight must only accept the coordination in the system. Thus, the workload of operators/coordinators is significantly reduced, together with any errors due to misinterpretation, lapse of memory or neglect.

3.5. **Flow chart**



3.6. **Implementation testing phases**

3.6.1. **First phase**

3.6.1.1. ATC automated systems must be configured in such a way that they can mimic as best as possible the times and distances contemplated by controllers for starting coordination with adjacent control units.

3.6.1.2. Whoever adapts and configures the system must know which will be the mailboxes to be used for testing (its own and those of the counterpart).

3.6.1.3. It should be noted that tests would take place between simulators and all AFTN/AMHS addresses of those control units that will not be affected by the tests must be blocked. For example, the addresses of aerodromes to which take-off messages are normally sent automatically must be removed from the databases.

3.6.2. **Second phase**

3.6.2.1. A test protocol--covering the widest possible range of cases--will be developed to conduct tests between the two control units, with the participation of technical, database management, and operational personnel.

3.6.2.2. Tests will involve generating FPLs in both control units and verifying that the systems automatically transmit the notification and coordination messages in accordance with the times and distances established in the configuration.

3.6.2.3. It is recommended that the AIDC or TEST designator be used as the aircraft ID (box 07), followed by a test sequence number.

3.6.2.4. In case the CPL modality is used for initial coordination messages, it must be ensured that this message will generate and activate an FPL in the receiving unit if such FPL does not yet exist.

3.6.2.5. The test will also involve verifying the proper operation of acceptance, rejection, and transfer messages, and an analysis of the reasons why the system may be sending or receiving LRM messages.

3.6.3. **Third phase**

3.6.3.1. Once the previous phase has been successfully completed and the correct exchange of messages between the systems has been verified, operational tests will be conducted with the participation of supervisors, instructors, and controllers of each control unit.

3.6.3.2. To complete this stage, consideration should be given to training of operational personnel on the use of AIDC and its benefits.

3.6.4. **Fourth phase**

3.6.4.1. Once AIDC coordination procedures have been tested and accepted by the operational personnel, the new letters of agreement will be signed between the control units, incorporating AIDC as an alternate means of coordination initially, sand subsequently as the main means of coordination.

APPENDIX A

SAM IPV4 REDDIG LAN NETWORK ADDRESSING PLAN BY STATE

1. In order to define the SAM IPv4 addressing plan, address assignments for each State that must and are being applied are listed below.

Región	Nro	Estado / Territorio	Red	Direcciones utilizables	Notacion Decimal	Notacion Binaria	Región	Estado / Territorio	Host's
SAM	1	Argentina	10.0.0.0 / 19	Primera	10 . 0 . 0 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 0 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 0 . 31 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 0 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	2	Chile	10.0.32.0 / 19	Primera	10 . 0 . 32 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 0 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 0 . 63 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 0 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	3	Brasil	10.0.64.0 / 19	Primera	10 . 0 . 64 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 0 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 0 . 95 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 0 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	4	Uruguay	10.0.96.0 / 19	Primera	10 . 0 . 96 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 0 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 0 . 127 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 0 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	5	Paraguay	10.0.128.0 / 19	Primera	10 . 0 . 128 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 1 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 0 . 159 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 1 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	6	Bolivia	10.0.160.0 / 19	Primera	10 . 0 . 160 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 1 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 0 . 191 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 1 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	7	Peru	10.0.192.0 / 19	Primera	10 . 0 . 192 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 1 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 0 . 223 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 1 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	8	Ecuador	10.0.224.0 / 19	Primera	10 . 0 . 224 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 1 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 0 . 255 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 0 . 1 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	9	Colombia	10.1.0.0 / 19	Primera	10 . 1 . 0 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 0 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 1 . 31 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 0 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	10	Venezuela	10.1.32.0 / 19	Primera	10 . 1 . 32 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 0 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 1 . 63 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 0 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	11	Guyana	10.1.64.0 / 19	Primera	10 . 1 . 64 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 0 1 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 1 . 95 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 0 1 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	12	Surinam	10.1.96.0 / 19	Primera	10 . 1 . 96 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 0 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 1 . 127 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 0 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	13	Guyana Francesa (France)	10.1.128.0 / 19	Primera	10 . 1 . 128 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 1 0 0	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 1 . 159 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 1 0 0	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	20	Trinidad y Tobago	10.18.96.0 / 19	Primera	10 . 18 . 96 . 1	0 0 0 0 1 0 1 0 .	0 0 0 1	0 0 1 0 . 0 1 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 18 . 127 . 254	0 0 0 0 1 0 1 0 .	0 0 0 1	0 0 1 0 . 0 1 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0
	-	VACANTE	10.1.160.0 / 19	Primera	10 . 1 . 160 . 1	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 1 0 1	0 0 0 0 0 . 0 0 0 0 0 0 0 1
				-	-			-	
				-	-			-	
				Ultima	10 . 1 . 191 . 254	0 0 0 0 1 0 1 0 .	0 0 0 0	0 0 0 1 . 1 0 1	1 1 1 1 1 . 1 1 1 1 1 1 1 0

APPENDIX B

SAM IPV4 REDDIG WAN ADDRESSING PLAN FOR THE INTERCONNECTION BETWEEN STATES

1. In order to define the SAM IPv4 REDDIG WAN addressing plan for serial links for the interconnection between States, address assignments that must and are being applied are listed below.

Red	Enlace				
	Nro.	Subred	Extremos	Direcciones a utilizar	
10.15.224.0 / 19	1	10.15.224.0 / 30	Argentina-Bolivia	-	10 . 15 . 224 . 0 / 30
				Argentina	10 . 15 . 224 . 1 / 30
				Bolivia	10 . 15 . 224 . 2 / 30
				-	10 . 15 . 224 . 3 / 30
	2	10.15.224.4 / 30	Argentina-Chile	-	10 . 15 . 224 . 4 / 30
				Argentina	10 . 15 . 224 . 5 / 30
				Chile	10 . 15 . 224 . 6 / 30
				-	10 . 15 . 224 . 7 / 30
	3	10.15.224.8 / 30	Argentina-Paraguay	-	10 . 15 . 224 . 8 / 30
				Argentina	10 . 15 . 224 . 9 / 30
				Paraguay	10 . 15 . 224 . 10 / 30
				-	10 . 15 . 224 . 11 / 30
	4	10.15.224.12 / 30	Argentina-Peru	-	10 . 15 . 224 . 12 / 30
				Argentina	10 . 15 . 224 . 13 / 30
				Peru	10 . 15 . 224 . 14 / 30
				-	10 . 15 . 224 . 15 / 30
	5	10.15.224.16 / 30	Argentina-Uruguay	-	10 . 15 . 224 . 16 / 30
				Argentina	10 . 15 . 224 . 17 / 30
				Uruguay	10 . 15 . 224 . 18 / 30
				-	10 . 15 . 224 . 19 / 30
	6	10.15.224.20 / 30	Argentina-AFI	-	10 . 15 . 224 . 20 / 30
				Argentina	10 . 15 . 224 . 21 / 30
				AFI (Johannesburgo)	10 . 15 . 224 . 22 / 30
				-	10 . 15 . 224 . 23 / 30
	7	10.15.224.24 / 30	Brasil-Colombia	-	10 . 15 . 224 . 24 / 30
				Brasil	10 . 15 . 224 . 25 / 30
				Colombia	10 . 15 . 224 . 26 / 30
				-	10 . 15 . 224 . 27 / 30
	8	10.15.224.28 / 30	Brasil-Guyana	-	10 . 15 . 224 . 28 / 30
				Brasil	10 . 15 . 224 . 29 / 30
				Guyana	10 . 15 . 224 . 30 / 30
				-	10 . 15 . 224 . 31 / 30
	9	10.15.224.32 / 30	Brasil-Guyana Francesa	-	10 . 15 . 224 . 32 / 30
				Brasil	10 . 15 . 224 . 33 / 30
				Guyana Francesa	10 . 15 . 224 . 34 / 30
				-	10 . 15 . 224 . 35 / 30

Red	Enlace				
	Nro.	Subred	Extremos	Direcciones a utilizar	
10.15.224.0 / 19	10	10.15.224.36 / 30	Brasil-Peru	-	10 . 15 . 224 . 36 / 30
				Brasil	10 . 15 . 224 . 37 / 30
				Peru	10 . 15 . 224 . 38 / 30
				-	10 . 15 . 224 . 39 / 30
	11	10.15.224.40 / 30	Brasil-Surinam	-	10 . 15 . 224 . 40 / 30
				Brasil	10 . 15 . 224 . 41 / 30
				Surinam	10 . 15 . 224 . 42 / 30
				-	10 . 15 . 224 . 43 / 30
	12	10.15.224.44 / 30	Brasil-Venezuela	-	10 . 15 . 224 . 44 / 30
				Brasil	10 . 15 . 224 . 45 / 30
				Venezuela	10 . 15 . 224 . 46 / 30
				-	10 . 15 . 224 . 47 / 30
	13	10.15.224.48 / 30	Brasil-AFI (tentativo)	-	10 . 15 . 224 . 48 / 30
				Brasil	10 . 15 . 224 . 49 / 30
				AFI (Dakar)	10 . 15 . 224 . 50 / 30
				-	10 . 15 . 224 . 51 / 30
	14	10.15.224.52 / 30	Brasil-EUR (tentativo)	-	10 . 15 . 224 . 52 / 30
				Brasil	10 . 15 . 224 . 53 / 30
				EUR (Madrid)	10 . 15 . 224 . 54 / 30
				-	10 . 15 . 224 . 55 / 30
	15	10.15.224.56 / 30	Brasil-NAM	-	10 . 15 . 224 . 56 / 30
				Brasil	10 . 15 . 224 . 57 / 30
				NAM(Atlanta)	10 . 15 . 224 . 58 / 30
				-	10 . 15 . 224 . 59 / 30
	16	10.15.224.60 / 30	Brasil-Argentina	-	10 . 15 . 224 . 60 / 30
				Brasil	10 . 15 . 224 . 61 / 30
				Argentina	10 . 15 . 224 . 62 / 30
				-	10 . 15 . 224 . 63 / 30
	17	10.15.224.64 / 30	Brasil-Bolivia	-	10 . 15 . 224 . 64 / 30
				Brasil	10 . 15 . 224 . 65 / 30
				Bolivia	10 . 15 . 224 . 66 / 30
				-	10 . 15 . 224 . 67 / 30
	18	10.15.224.68 / 30	Brasil-Paraguay	-	10 . 15 . 224 . 68 / 30
				Brasil	10 . 15 . 224 . 69 / 30
				Paraguay	10 . 15 . 224 . 70 / 30
				-	10 . 15 . 224 . 71 / 30

Red	Enlace				
	Nro.	Subred	Extremos	Direcciones a utilizar	
10.15.224.0 / 19	19	10.15.224.72 / 30	Brasil-Uruguay	-	10 . 15 . 224 . 72 / 30
				Brasil	10 . 15 . 224 . 73 / 30
				Uruguay	10 . 15 . 224 . 74 / 30
				-	10 . 15 . 224 . 75 / 30
	20	10.15.224.76 / 30	Chile-PAC	-	10 . 15 . 224 . 76 / 30
				Chile	10 . 15 . 224 . 77 / 30
				PAC(Christchurch)	10 . 15 . 224 . 78 / 30
				-	10 . 15 . 224 . 79 / 30
	21	10.15.224.80 / 30	Chile-Peru	-	10 . 15 . 224 . 80 / 30
				Chile	10 . 15 . 224 . 81 / 30
				Peru	10 . 15 . 224 . 82 / 30
				-	10 . 15 . 224 . 83 / 30
	22	10.15.224.84 / 30	Colombia-NAM	-	10 . 15 . 224 . 84 / 30
				Colombia	10 . 15 . 224 . 85 / 30
				NAM (Atlanta)	10 . 15 . 224 . 86 / 30
				-	10 . 15 . 224 . 87 / 30
	23	10.15.224.88 / 30	Colombia-Ecuador	-	10 . 15 . 224 . 88 / 30
				Colombia	10 . 15 . 224 . 89 / 30
				Ecuador	10 . 15 . 224 . 90 / 30
				-	10 . 15 . 224 . 91 / 30
	24	10.15.224.92 / 30	Colombia-Peru	-	10 . 15 . 224 . 92 / 30
				Colombia	10 . 15 . 224 . 93 / 30
				Peru	10 . 15 . 224 . 94 / 30
				-	10 . 15 . 224 . 95 / 30
	25	10.15.224.96 / 30	Colombia-Venezuela	-	10 . 15 . 224 . 96 / 30
				Colombia	10 . 15 . 224 . 97 / 30
				Venezuela	10 . 15 . 224 . 98 / 30
				-	10 . 15 . 224 . 99 / 30
	26	10.15.224.100 / 30	Ecuador-Peru	-	10 . 15 . 224 . 100 / 30
				Ecuador	10 . 15 . 224 . 101 / 30
				Peru	10 . 15 . 224 . 102 / 30
				-	10 . 15 . 224 . 103 / 30
	27	10.15.224.104 / 30	Ecuador-Venezuela	-	10 . 15 . 224 . 104 / 30
				Ecuador	10 . 15 . 224 . 105 / 30
				Venezuela	10 . 15 . 224 . 106 / 30
				-	10 . 15 . 224 . 107 / 30

Red	Enlace				
	Nro.	Subred	Extremos	Direcciones a utilizar	
10.15.224.0 / 19	28	10.15.224.108 / 30	Guyana Francesa-Surinam	-	10 . 15 . 224 . 108 / 30
				Guyana Francesa	10 . 15 . 224 . 109 / 30
				Surinam	10 . 15 . 224 . 110 / 30
				-	10 . 15 . 224 . 111 / 30
	29	10.15.224.112 / 30	Guyana-C-CAR	-	10 . 15 . 224 . 112 / 30
				Guyana	10 . 15 . 224 . 113 / 30
				C-CAR (Piarco)	10 . 15 . 224 . 114 / 30
				-	10 . 15 . 224 . 115 / 30
	30	10.15.224.116 / 30	Guyana-Surinam	-	10 . 15 . 224 . 116 / 30
				Guyana	10 . 15 . 224 . 117 / 30
				Surinam	10 . 15 . 224 . 118 / 30
				-	10 . 15 . 224 . 119 / 30
	31	10.15.224.120 /30	Guyana-Venezuela	-	10 . 15 . 224 . 120 / 30
				Guyana	10 . 15 . 224 . 121 / 30
				Venezuela	10 . 15 . 224 . 122 / 30
				-	10 . 15 . 224 . 123 / 30
	32	10.15.224.124 / 30	Peru-NAM	-	10 . 15 . 224 . 124 / 30
				Peru	10 . 15 . 224 . 125 / 30
				NAM (Atlanta)	10 . 15 . 224 . 126 / 30
				-	10 . 15 . 224 . 127 / 30
	33	10.15.224.128 / 30	Peru-Bolivia	-	10 . 15 . 224 . 128 / 30
				Peru	10 . 15 . 224 . 129 / 30
				Bolivia	10 . 15 . 224 . 130 / 30
				-	10 . 15 . 224 . 131 / 30
	34	10.15.224.132 / 30	Peru-Colombia	-	10 . 15 . 224 . 132 / 30
				Peru	10 . 15 . 224 . 133 / 30
				Colombia	10 . 15 . 224 . 134 / 30
				-	10 . 15 . 224 . 135 / 30
	35	10.15.224.136 / 30	Peru-Venezuela	-	10 . 15 . 224 . 136 / 30
				Peru	10 . 15 . 224 . 137 / 30
				Venezuela	10 . 15 . 224 . 138 / 30
				-	10 . 15 . 224 . 139 / 30
	36	10.15.224.140 / 30	Surinam-Venezuela	-	10 . 15 . 224 . 140 / 30
				Surinam	10 . 15 . 224 . 141 / 30
				Venezuela	10 . 15 . 224 . 142 / 30
				-	10 . 15 . 224 . 143 / 30

Red	Enlace				
	Nro.	Subred	Extremos	Direcciones a utilizar	
	37	10.15.224.144 / 30	Venezuela-CAM	-	10 . 15 . 224 . 144 / 30
				Venezuela	10 . 15 . 224 . 145 / 30
				CAM (San Juan)	10 . 15 . 224 . 146 / 30
				-	10 . 15 . 224 . 147 / 30
	38	10.15.224.148 / 30	Venezuela-EUR	-	10 . 15 . 224 . 148 / 30
				Venezuela	10 . 15 . 224 . 149 / 30
				EUR (Madrid)	10 . 15 . 224 . 150 / 30
				-	10 . 15 . 224 . 151 / 30
	39	10.15.224.152 / 30	Venezuela-Trinidad y Tobago	-	10 . 15 . 224 . 152 / 30
				Venezuela	10 . 15 . 224 . 153 / 30
				Trinidad y Tobago	10 . 15 . 224 . 154 / 30
				-	10 . 15 . 224 . 155 / 30
	40	10.15.224.156 / 30	VACANTE	-	10 . 15 . 224 . 156 / 30
					10 . 15 . 224 . 157 / 30
					10 . 15 . 224 . 158 / 30
				-	10 . 15 . 224 . 159 / 30
10.15.224.0 / 19	41	10.15.224.160 / 30	VACANTE	-	10 . 15 . 224 . 160 / 30
					10 . 15 . 224 . 161 / 30
					10 . 15 . 224 . 162 / 30
				-	10 . 15 . 224 . 163 / 30
	42	10.15.224.164 / 30	VACANTE	-	10 . 15 . 224 . 164 / 30
					10 . 15 . 224 . 165 / 30
					10 . 15 . 224 . 166 / 30
				-	10 . 15 . 224 . 167 / 30
	-	-	-	-	-
					-
					-
				-	-
	-	-	-	-	-
					-
					-
				-	
	2048 (última)	10.15.31.252 / 30	VACANTE	-	10 . 15 . 31 . 252 / 30
					10 . 15 . 31 . 253 / 30
					10 . 15 . 31 . 254 / 30
				-	10 . 15 . 31 . 255 / 30

APPENDIX C

LAN REDDIG IPV4 ADDRESSING SCHEME PER STATE

1. With the aim of setting the IPV4 SAM addressing plan, hereunder is the assignment of addresses for each State, and that should be and is being applied upon.
SAM Region: Assignment of networks per State

No	State/Territory	Network	Usable Addresses	Decimal Notation
1	Argentina	10.0.0.0 / 19	First	10.0.0.1
			-	-
			-	-
			Last	10.0.31.254
2	Chile	10.0.32.0 / 19	First	10.0.32.1
			-	-
			-	-
			Last	10.0.65.254
3	Brasil	10.0.64.0 / 19	First	10.0.64.1
			-	-
			-	-
			Last	10.0.95.254
4	Uruguay	10.0.96.0 / 19	First	10.0.96.1
			-	-
			-	-
			Last	10.0.127.254
5	Paraguay	10.0.128.0./ 19	First	10.0.128.1
			-	-
			-	-
			Last	10.0.159.254
6	Bolivia	10.0.160.0 / 19	First	10.0.160.1
			-	-
			-	-
			Last	10.0.191.254
7	Perú	10.0.192.0 / 19	First	10.0.192.1
			-	-
			-	-
			Last	10.0.223.254
8	Ecuador	10.0.224.0 / 19	First	10.0.224.1
			-	-
			-	-
			Last	10.0.255.254

No	State/Territory	Network	Usable Addresses	Decimal Notation
9	Colombia	10.1.0.0 / 19	First	10.1.0.1
			-	-
			-	-
			Last	10.1.31.254
10	Venezuela	10.1.32.0 / 19	First	10.1.32.1
			-	-
			-	-
			Last	10.1.63.254
11	Guyana	10.1.64.0 / 19	First	10.1.64.1
			-	-
			-	-
			Last	10.1.95.254
12	Surinam	10.1.96.0 / 19	First	10.1.96.1
			-	-
			-	-
			Last	10.1.127.254
13	Guyana Francesa (Francia)	10.1.128.0 / 19	First	10.1.128.1
			-	-
			-	-
			Last	10.1.159.254
14	Trinidad y Tobago	10.18.96.0 / 19.	First	10.18.96.1
			-	-
			-	-
			Last	10.18.127.254
15	Vacante	10.1.160.0 / 19	First	10.1.160.1
			-	-
			-	-
			Last	10.1.191.254

APPENDIX D

COMPOSITION OF ATS MESSAGES

ATS message fields

Field	Element (a)	Element (b)	Element (c)	Element (d)	Element (e)
03	Message type designator	Message number	Reference data		
07	Aircraft identifier	SSR mode	SSR code		
09	Number of aircraft	Aircraft type	Wake turbulence category		
10	Radio communication and navigation and approach aid equipment and capabilities	Surveillance equipment and capabilities			
13	Aerodrome of departure	Time			
14	Control point	Time at control point	Cleared level	Supplementary data	Conditions
15	Cruising speed	Cruising level	Route		
16	Destination aerodrome	Total estimated elapsed time	Destination alternates		
18	Other data				
22	Field indicator	Modified data			
31	Facility designator	Sector designator			
32	Time	Position	Trace ground speed	Trace heading	Reported altitude

FPL (filed flight plan)

FPL field	Required elements	Optional elements	Comments
03	a. b.		
07	a.	b. c.	The SSR code is sent only if one has already been assigned and the aircraft is equipped for it.
08	a.	b.	Element (b) is included if so required by the boundary agreement.
09	b. c.	a.	
10	a. b.		
13	a. b.		
15	a. b. c.		
16	a. b.	c.	

FPL field	Required elements	Optional elements	Comments
18		a. Other information	Element (a) is included only if no other information is provided. Any element (a) or other information (but not both) should be included.

ABI (reporting message)

ABI field	Required elements	Optional elements	Comments
03	a.		Element (c) shall contain the reference number of the first message sent for this flight.
07	a.	b. c.	If an SSR code has been assigned, it must be included.
13	a.		
14	a. b. c. d. e.		
16	a.		
22			

CPL (current flight plan)

CPL field	Required elements	Optional elements	Comments
03	a. b.		
07	a.	b. c.	The SSR code is only sent if one has already been assigned and the aircraft is equipped for it.
08	a. b.		Element (b) is included if so required by the boundary agreement.
09	b. c.	a.	
10	a. b.		
13	a.		
14	a. b. c.	d. e.	
15	a. b. c.		
16	a.		
18		a. Other information	Element (a) is included only if no other information is included. Any element (a) or other information (but not both) must be included.

EST (estimates)

EST field	Required elements	Optional elements	Comments
03	a. b. c.		Element (c) shall contain the reference number of the last message sent for this flight.
07	a.	b. c.	The SSR code is sent only if one has ben assigned and the aircraft is equipped for it.
13	a.		The aerodrome of departure must match the value previously sent in the FPL or the last CHG that modified the FPL.
14	a. b. c.	d. e.	
16	a.		The destination aerodrome must match the value previously sent in the FPL or the last CHG that modified the FPL.

CDN (coordination message)

CDN field	Required elements	Optional elements	Comments
03	a. b. c.		
07	a.	b. c.	
13	a. b.		
14	a. b. c.	d.	
16	a.		

ACP (acceptance message)

ACP field	Required elements	Optional elements	Comments
03	a. b. c.		
07	a.	b. c.	
13	a. b.		
16	a.		

RJC (rejection message)

RJC field	Required elements	Optional elements	Comments
03	a. b. c.		
07	a.	b. c.	
13	a. b.		
16	a.		

TOC (transfer of control message)

TOC field	Required elements	Optional elements	Comments
03	a. b. c.		
07	a.	b. c.	
13	a. b.		
16	a.		

AOC (assumption of control)

AOC field	Required elements	Optional elements	Comments
03	a. b. c.		
07	a.	b. c.	
13	a. b.		
16	a.		

LAM (logical acknowledgment message)

LAM field	Required elements	Optional elements	Comments
03	a. b. c.		

LRM (logical rejection message)

LRM field	Required elements	Optional elements	Comments
03	a. b. c.		
18	Text as shown in the comments		Describes the error code: after RMK /, includes two digits for the error code.

APPENDIX E

LIST OF ACRONYMS

ABI	Advance Boundary Information (AIDC message)
ACC	Area Control Centre
ACP	Acceptance (AIDC message)
ADS	Surveillance ADS-C (AIDC message)
ADS-B	Automatic Dependent Surveillance - Broadcast
ADS-C	Automatic Dependent Surveillance - Contract
AFTN	Aeronautical Fixed Telecommunications Network
AIDC	ATS Interfacility Data Communications
AMHS	Aeronautical Message Handling System
AMHS	ATS Message Handling System
AOC	Airline Operational Control; or Assumption of Control (AIDC message)
APP	Approach Control Office
ASCII	American Standard Code for Information Interchange
ASIA/PAC	Asia/Pacific
ATC	Air Traffic Control
ATM	Air Traffic Management
ATN	Aeronautical Telecommunications Network
ATS	Air Traffic Services
ATSU	Air Traffic Service Unit
CAAS	Common AMHS Addressing Scheme
CARSAM	Caribbean – South America
CCAM	*Centro de Conmutación Automática de Mensajes* (Automatic message switching centre)
CDN	Coordination (AIDC message)
CH	AFTN Channel
CHG	ICAO Modification Message
CNS	Communications, Navigation, Surveillance
CPDLC	Controller Pilot Data Link Communications
CPL	Current Flight Plan (AIDC message)
DS	Directory server that communicates using X.500 protocols
DS	Directory Service
EST	Coordination Estimate (AIDC message)
FPL	Filed Flight Plan
IA-5	International Alphabet 5
ICAO	International Civil Aviation Organization
ICD	Interface Control Document
IP	Internet Protocol
IPM	Inter Personal Message
IPv4	Internet Protocol version 4
IPv4 REDDIG SAM	IP addressing plan, version 4. Uses the REDDIG and corresponds to the SAM Region
ITA-2	International Telegraph Alphabet No. 2
LAM	Logical Acknowledgement Message (AIDC message)
LRM	Logical Rejection Message (AIDC message)
MS	Message storage for handling message delivery and retrieval

MTA	Agent responsible for routing messages between MTAs, MSs and MTAs Message Transfer Agent
MTCU	Message Transfer and Conversion Unit
NAT	Network Address Translation
NAT:	IP address translation protocol
OSI	Open System Inter-connection
P1	Protocol for communicating and routing messages between MTAs (ITU-T X.411)
P3	Delivery protocol (“pull”)
P7	Protocol for the UA to withdraw from MS (ITU-T X.413) (“push”)
REDDIG	South American Digital Network
REDDIG LAN	Environment associated to the regional IP addressing plan for each State
REDDIG WAN	Environment associated to the regional IP addressing plan for interconnection between States
REJ	Rejection (AIDC message)
Speech ATS	Speech circuit for ATS communications
TCP	Transfer of Control Point
TOC	Transfer of Control (AIDC message)
TWR	Aerodrome control tower
UA	User Agent
UTC	Universal Coordinated Time

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 the following papers:

a) WP/06 - *Activities to be taken under consideration in the proposed Action Plan of the Project Improve ATM Situational Awareness in the SAM Region* (C2 Project Coordinator); and
b) WP/10 - *Follow-up to the Automation Project implementation activities* (Secretariat).

6.2 In this respect, the following topics were reviewed upon:

a) Follow-up to the activities of Project C1 – Automation; and
b) Follow-up to the activities of Project C2 - Improve ATM Situational Awareness.

Follow-up to the activities of Project C1 – Automation

6.3 The basic activities of this Project consist in the drafting of various guidelines, which were all elaborated, as well as in the interconnection of automated systems between adjacent ACCs in the Region.

Interconnection of automated systems

6.4 The Meeting noted that five (5) memoranda of understanding (MoUs) have been signed since 2009 for the interconnection of radar data and automatic hand-off of flight plans between neighbouring countries, but no major progress has been made. Only some progress has been made for the exchange of radar data using the IP protocol between the radars of Durazno in Uruguay and Quilmes in Argentina, but no operational use has been established yet.

6.5 The Meeting was informed on the results of the new trials conducted in Brazil during the period from 8 to 13 May 2013 for the integration of the Maiquetia ACC and the Amazonico ACC, part of the activities scheduled in the planning for the integration of CNS/ATM systems in the CAR/SAM Regions.

6.6 During the works in Manaos, Brazil, the Meeting noted that for a better analysis of the problem, the Brazilian Administration had prepared a trial environment similar to the operational one, composed by a router, a firewall, a hub and two computers, one to simulate the ACC-AZ (Manaos) RDP, with ASTERIX CAT 62/63 radar trace transmission, via UDP protocol, and the other, to simulate trace reception, before REDDIG.

6.7 The Meeting was informed that the following activities were still pending, to be coordinated between Brazil and Venezuela, as they were necessary to complete the operational use of the automated handoff between the ACC-AZ (Manaos) and ACC-MI (Maiquetía):

a) Verification and eventual adjustments to the communications infrastructure in the ACC Maiquetia for the respective interconnection;
b) Final interconnection tests, with the transmission of radar traces and flight plans between the ACC-AZ and ACC-MI. Therefore, coordination between the ACC-AZ and del ACC-MI technical and operational teams become necessary;

c) Review of the operational agreement for the transfer of traffic between ACC-AZ and ACC-MI, taking under consideration the automated handoff; and
d) Verification on the need to train the ACC-MI and ACC-AZ operators on the use of the automated handoff.

6.8 In order to assist States in finding solutions for the completion of the interconnection, the Meeting considered the results obtained in the following actions, foreseen in SAM/IG/10 meeting:

a) The C1 Project Coordinator drafted a questionnaire on automated systems interconnection requirements, presented as Appendix A to WP/10. The Secretariat sent letter LT 12/3.54 – SA130 of 11 March 2013 to Argentina, Brazil, Chile, Peru and Uruguay, with the aim of identifying the reasons for the delays and formulate recommendations permitting the completion of the interconnections. Replies were received from Argentina, Brazil, Chile and Peru, summarized in **Appendix A** to Agenda Item. The Meeting urged the administration of Uruguay to complete the survey and submit it to the ICAO SAM Regional Office as soon as possible; and
b) The Secretariat sent letter LT 12/3.54 – SA607 of 2 November 2012, requesting States to update the SICD document (*System Interface Control Document for the Interconnection of ACC Centres of the CARSAM Region*), which describes the surveillance systems, as well as the automated systems (radar data and flight plan processors). In this respect, there is updated information from Brazil. The rest will be updated after the completion of the visits to States.

6.9 The Meeting took note that the visits scheduled for April 2013 to States who had drafted Memoranda of Understanding (MoU) for the interconnection of automated systems had been postponed for the second semester of 2013. The results obtained will be presented at SAM/IG/12 meeting.

6.10 In view of the obstacles that some States reported with regard to the provision of ICD from the automated centres, Brazil presented the possibility of using the radar data analysis and centres tools (SASS-C and RAPS-3) during the visits to be conducted by the experts to the selected ATS automated centres of the Region.

6.11 The Meeting updated the Project C1 document on the basis of the progress made in the implementation of the activities therein considered, shown in **Appendix B** to this Agenda Item.

Follow-up to the activities of Project C2 - Improve ATM Situational Awareness

6.12 The Meeting examined the *Guideline on technical operational considerations for ADS-B implementation,* which includes comments made by Brazil, Chile y Guyana. The contributions were considered pertinent and accepted in the new Guide, revision 1.2, included in **Appendix C** to this Agenda Item.

6.13 Taking under consideration the new CNS roadmaps to be part of the *Global Air Navigation Plan*, fourth edition, and the *Air Navigation System Performance-Based Implementation Plan for the SAM Region (SAM PBIP)* updated with regard to the new ASBU methodology, the Meeting deemed that the *Regional surveillance strategy for the implementation of systems in support to situational awareness improvements*, was no longer necessary to be updated. In this sense, the Meeting recommended States that, for CNS technology availability planning and guidance, especially the surveillance systems, they refer to the CNS roadmaps.

6.14 As per the changes made in the tasks to the Situational Awareness Project, the Meeting updated the Project deliverables. The updated table is shown in **Appendix D** to this Agenda item.

APPENDIX A

PROJECT C1
INTERCONNECTION OF AUTOMATED SYSTEMS QUESTIONNAIRE – REPLIES FROM STATES

1. BACKGROUND

The ICAO Lima Office sent States a questionnaire containing questions on the air traffic control automated systems, with the aim of counting with a detailed vision on the difficulties to make the interconnection programmed in Project C1.

To date, only 4 States, Argentina, Brazil, Chile and Peru, replied to the questionnaire.

The results are presented hereunder.

2. ANALYSIS

The analysis made to the replies enables the following observation:

1. Radar data

- Argentina and Peru have automated systems from the same manufacturer, INDRA. The versions installed in each State is unknown;
- Chile has a T Eurocat C hales automated system;
- The ACC-CW and ACC-AZ automated systems in Brazil are different. The ACC-AZ system is planned to be changed in the end of July 2013 by a SAGITARIO system, similar to the ACC-CW;
- The RDPS have multitrack processing capabilities. The ACC-CW SAGITARIO has capability for ADS-B/C and multilateration. The Argentina INDRA system has ADS-B/C capability. Information was not received as to whether the Peruvian system has ADS-B/C capability;
- All systems have radar data transfer capability through ASTERIX CAT 62/63, but Argentina does not have it habilitated and requires the purchasing of licenses. In this case, the use of data directly from the radar is proposed, through ASTERIX CAT 1/2;
- The Chilean system has capacity for the use of ASTERIX CAT 62 and 65, but is not sure with regard to ASTERIX CAT 63 (to be confirmed). Its proposal is to initially share data directly from the Puerto Montt radar, with the use of ASTERIX CAT 1/2 for its later transfer between centres;
- The ASTERIX ICD of the Chilean system is unknown;
- The documentation adopted by the INDRA system regarding ASTERIX protocol is unknown. The Brazil SAGITARIO adopts the EUROCONTROL documentation.

2. Flight plans

2.1. AIDC

- Argentina counts with AIDC functions, but still does not use handoff between domestic centres;
- AIDC is not implemented in the Chilean system, even though it has capability. The ICD is based on the ASIA/PAC Region specifications (V 2.0, 28 March 2003);
- Brazil has this function in its ACC-CW SAGITARIO system, but still does not use AIDC for the handoff between domestic centres, which is done with the use of Doc 4444 messages. The estimate date for AIDC operational use is the end of 2013;

- AIDS implementation in the SAGITARIO system took under consideration the ASIA/PAC Region IDC;
- Peru counts with AIDC functions, but still does not use the handoff between domestic centres;
- All States can transmit messages through AMHS;
- Chile does not use AIDC.

2.2. OLDI

- Argentina counts with OLDI functions, implemented by INDRA. The specifications adopted are unknown. Argentina informed it has no interest in the future use of OLDI for the handoff, both internally as externally, as it is trying to use AIDC;
- Chile has and uses OLDI for the handoff between its automated systems, through an internal data network. The handoff is manual, with previous coordinations carried out in automated manner.
- In Brazil, the ACC-CW SAGITARIO system counts with OLDI functions, on the basis of EUROCONTROKL specifications, but it still does not use handoff between domestic centres. In the event of implementation, the transmission will be conducted through AMHS.
- Peru counts with OLDI functions, implemented by INDRA. The specifications adopted are unknown.

2.3. Others

- The Brazilian automated systems, including SAGITARIO and X-4000, count with handoff functions on the basis of Doc 4444 and uses them for the automated handoff between the national control centres, both in the ACC, as in the APP and TWR.

3. Connection and safety

- The Argentinean radars count with IP addresses and are integrated to a national ATN network, based on TCP/IP. The routing is made in Ezeiza;
- The Brazilian and Peruvian RDPS systems count with IP addresses from the LAN;
- The Argentinean automated system is protected by a router with firewall functions;
- Brazil is trying to implement a firewall for the protection of the ACC-CW automated system. The ACC-AZ already counts with a firewall;
- Argentina and Brazil count with routers connected to REDDIG. Peru only furnished information on the REDDIG MUX MEMOTEC;
- Argentina and Brazil already count with NAT configurations;
- Chile has no firewall implemented in the network topology proposed for the interconnection or radar data.

APPENDIX B

PROJECT AUTOMATION

SAM Region	**PROJECT DESCRIPTION (DP)**	**PD N° C1**	
Programme	**Project Title**	**Starting Date**	**Ending Date**
Automation and ATM Situational Awareness *(Programme Coordinator: Onofrio Smarrelli)*	Automation *Project Coordinator: Alessander Santoro (Brazil)* *Contributing experts: SAM/IG ATM Automation Group*	May 2008	June 2016
Objective	Support States of the SAM Region in the implementation of automated systems, and in their regional interconnection		
Scope	The scope of the project includes the initial drafting of guidelines, trials for the identification of the automation level required at the Region's ATS units in the short and medium term, and the implementation of automation systems and their interconnection through the VSAT based South American digital network (REDDIG)		
Metrics	• Drafting of the following documents: ✓ Guidance document on automated systems requirements at ATS units (SSS) ✓ Guideline for the implementation of integrated automated systems ✓ Action plan for the interconnection of automated systems ✓ Preliminary interface control document (ICD) between systems for the interconnection of ACCs in the SAM Region ✓ Memorandum of Understanding (MoU) model for the interconnection of automated systems • Interconnection of automated systems between adjacent ACCs in the SAM Region: • Reduction in number of operational errors, including LHD in the SAM Region		
Strategy	• All tasks will be conducted by experts nominated by States and organizations of the SAM Region members of the Project *Automation*, under management of the project coordinator, in coordination with the programme coordinator. Communications among project members, as well as between the project coordinator and programme coordinator, shall be carried out through teleconferences and the Internet. In addition, the programme coordinator, together with the project coordinator and the contributing experts, can convene at SAM/IG implementation meetings • Once studies are completed, the results will be submitted to the ICAO programme coordinator as a final consolidated document for its analysis, review, approval and presentation at the GREPECAS PPRC		

Justification	• The CAR/SAM air traffic control centres have had difficulties in duly coordinating air traffic, an important factor contributing in air traffic incidents. The air traffic control automated centres' interconnection will permit a coordinated automated air traffic for the transfer of responsibilities between CAR/SAM adjacent area control centres, thus reducing the risk in aeronautical incidents generated by undue coordination activities and improving, at the same time, the planning phases for an efficient control of flights from/to corresponding Flight Information Regions (FIR). • The interconnection of automated systems would be facilitated, in view of REDDIG (SAM VSAT regional network), which has the necessary capability to transport automated systems applications • This project contributes towards the implementation of SAM PFF CNS 04, ATM 05 and ATM 06 of the *Air Navigation System Performance-Based Implementation Plan for the SAM Region (SAM PBIP)*
goals	• Initial drafting of five guideline documents in support of the implementation of automated systems interconnection for completion in the period (May 2008 – October 2012) • Initial drafting of 18 MoU for the interconnection of automated systems 5 MoU period 2009-2011 4 MoU for the end of 2012 9 MoU for the end of 2013 • Implementation of the interconnection of automated systems *Flight plan* 9 OLDI interconnections 2012-2014 1 interconnection considering Doc 44 for 2012 7 AIDC interconnections for period 2012-2013 *Asterix protocol radar data* 20 radar data exchanges using Asterix protocol period 2011-2014 1 owner exchange for 2012
Related Projects	• ATFM • Implementation of the New ICAO Flight Plan Model • Improve ATM Situational Awareness

Project Deliverables	Relationship with Performance Based Regional Plan (PFF)	Responsible	Status of Implementation[1]	Delivery Date	Remarks
Regional guideline document for the automation level required according to the ATM service provided in airspace and international aerodromes, assessing • operational architecture design, • characteristics and attributes for interoperability, • data bases and software FPL, CPL, CNL, RLA, etc, and • technical requirements.	PFF SAM CNS 04 PFF SAM ATM 05 PFF SAM ATM 06	Project Coordinator and ATM Automation Group		Completed June 2011	The System and Subsystem Specifications (SSS) document has been drafted for the identification of automated requirements necessary at ATS units (ACC), and a revision process has been conducted with the support of RLA/06/901 project and SAM/IG ATM Automation Group. Document published in site www.lima.icao.int.
Guideline for the integration of automated systems and corresponding action plan	PFF SAM CNS 04 PFF SAM ATM 05 PFF SAM ATM 06	Project Coordinator and ATM Automation Group		Completed October 2010 Completed May 2012	The following has been drafted: Guideline for the integration of automated systems and revision process. Action plan revision for the integration of automated systems and continuous revision. Both documents drafts with the support of RLA/06/901 project and the SAM/IG ATM Automation Group. Document published in site www.lima.icao.int.

[1] ***Gray****: Activity has not started*
Green*: Activity has or will deliver planned milestone as scheduled*
Yellow*: Activity is behind schedule on milestone, but still within acceptable parameters to deliver milestone on time*
Red*: Activity has failed to deliver milestone on time, mitigation measures need to be identified and implemented*

Project Deliverables	Relationship with Performance Based Regional Plan (PFF)	Responsible	Status of Implementation[1]	Delivery Date	Remarks
Preliminary interface control document (ICD) between systems for the interconnection of ACCs in the SAM Region	PFF SAM CNS 04 PFF SAM ATM 05 PFF SAM ATM 06	Programme Coordinator, Project Coordinator and ATM Automation Group		Completed October 2008 October 2012	Document ICD drafted. Document elaborated with the support of RLA/98/003 and later, RLA/06/901. Document published in site www.lima.icao.int. The document requires updating in view of installation of new automated and surveillance systems in the Region
Guidelines for elaboration of Memorandum of Understanding (MoU) for the implementation of the automation system interconnection	PFF SAM CNS 04	Project Coordinator and ATM Automation Group		Completed October 2009	A model MoU for the interconnection of automated systems has been developed, with the support of RLA/06/901 project and SAM/IG ATM Automation Group. The MoU model is published in site www.lima.icao.int.
Drafting of Memorandum of Understanding (MoU) for the interconnection of automated systems between adjacent ACCs	PFF SAM CNS 04 PFF SAM ATM 05 PFF SAM ATM 06	SAM States, Project Coordinator and ATM Automation Group		October 2013	To date, six MoU have been drafted and signed between the following SAM States: Argentina-Brazil; Argentina-Chile; Argentina-Uruguay, Brazil-Uruguay; Brazil-Peru; and Brazil-Venezuela. 12 additional MoUs are planned to be drafted.

Project Deliverables	Relationship with Performance Based Regional Plan (PFF)	Responsible	Status of Implementation[1]	Delivery Date	Remarks
Interconnection of automated systems between adjacent ACCs	PFF SAM CNS 04 PFF SAM ATM 05 PFF SAM ATM 06	SAM States		June 2016	1. Radar data has been interconnected between Argentina-Uruguay using IP protocol through REDDIG; 2. Flight plan and radar data exchange trials have been conducted between Brazil-Venezuela through REDDIG; 3. Letter LT 12/3.54-SA130 containing a questionnaire was sent to Argentina, Brazil, Chile, Peru and Uruguay with the aim of identifying the causes for the delays and formulate recommendations permitting the completion of the interconnections. Replies were received from Argentina, Brazil and Peru; 4. Replies from Argentina, Brazil and Peru were analysed upon; 5. A mission was programmed for 6 to 10 May 2013, involving two automation experts with the aim of restarting and concluding the interconnection trials between the Brazil and Venezuela systems. Visits to the remainder States will be scheduled for June-July 2013, with presentation of results at SAM/IG/12. 6. Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, panama, Paraguay, Peru, Uruguay and Venezuela were requested for the updating of the SICD document. SICD updating was received regarding the Brazilian automated systems

Project Deliverables	Relationship with Performance Based Regional Plan (PFF)	Responsible	Status of Implementation[1]	Delivery Date	Remarks
Monitor implementation progress of automation activities in the SAM Region		Programme Coordinator and Project Coordinator		September 2009-December 2014	
Resources necessary	Implement facilities required by SAM States permitting the interconnection of automated systems in accordance with the dates established in the MoUs drafted and signed to this end				

APPENDIX C

INTERNATIONAL CIVIL AVIATION ORGANIZATION
SOUTH AMERICAN REGIONAL OFFICE

ASSISTANCE FOR THE IMPLEMENTATION OF A REGIONAL ATM SYSTEM TAKING INTO ACCOUNT THE ATM OPERATIONAL CONCEPT AND THE CORRESPONDING CNS TECHNOLOGICAL SUPPORT

SAM IMPLEMENTATION GROUP - SAMIG

GUIDE ON TECHNICAL AND OPERATIONAL CONSIDERATIONS FOR THE IMPLEMENTATION OF ADS-B IN THE SAM REGION

Lima, Peru

Version 1.2

May 2013

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LIST OF ACRONYMS

A/A	Air/air
AC	Advisory circular
ACAS	Airborne collision avoidance system
ACC	Area control centre
ACID	Aircraft identification
ADLP	Airborne data link processor
ADS-B	Automatic dependent surveillance — broadcast
ADS-C	Automatic dependent surveillance — contract
ADS-R	Automatic dependent surveillance — rebroadcast
AIP	Aeronautical information publication
AIRPROX	Aircraft proximity incidents
ANSP	Air navigation service provider
ASBU	Aviation system block upgrades
ASD	Aircraft situation display
ASTERIX	All-purpose structured Eurocontrol surveillance information exchange
ATC	Air traffic control
ATCO	Air traffic controller
ATM	Air traffic management
ATN	Aeronautical telecommunication network
ATS	Air traffic service
BW	Bandwidth
CAA	Civil Aviation Authority
CDTI	Cockpit display of traffic information
CNS	Communications, navigation and surveillance
CPDLC	Controller-pilot data link communications
DME	Distance measuring equipment
ES	Extended squitter
FDP	Flight data processing
FIR	Flight information region
FMC	Flight management computer
FMS	Flight management system
FPL	Flight plan presented
GNSS	Global navigation satellite system
GPI	Global performance indicator
GPS	Global positioning system
GUI	Graphical user interface
IFR	Instrument flight rules
IMC	Instrument meteorological conditions
INS	Inertial navigation system
ISO	International Organization for Standardization
KVM	Keyboard, video and mouse
LAN	Local area network
MLAT	Multilateration
MSAW	Minimum safe altitude warning system
MSSR	Monopulse SSR
MTBF	Mean time between failures
NTP	Network time protocol
NAC	Navigation accuracy category

NIC	Navigation integrity category
NUC	Navigation uncertainty category
ICAO	International Civil Aviation Organization
PSR	Primary surveillance radar
RAIM	Receiver autonomous integrity monitoring
REDAP	Peruvian digital network
RF	Radio frequency
RNAV	Area navigation
RNP	Required navigation performance
RTCA	Radio Technical Commission for Aeronautics
SAM	ICAO South American Region
SARPs	ICAO standards and recommended practices
SDP	Surveillance data processing
SIC	System identification code
SIL	Surveillance integrity level
SLG	Local management system
SRG	Remote management system
SSR	Secondary surveillance radar
G/A	Ground/air
TCAS	Traffic alert and collision avoidance system
TGPS	All-purpose synchronization card
TIS	Traffic information service
TIS-B	Traffic information service — broadcast
TOA	Time of arrival
TPPG	All-purpose process card
TSO	United States FAA Technical Standard Order
TRPG	All-purpose reception card
TIS-B	Traffic information service — broadcast
UAT	Universal access transceiver
UDP	User datagram protocol
UPS	Uninterruptible power supply
URPA	ADS-B reception and processing unit
UTC	Coordinated universal time
VDL	VHF digital link
VHF	Very high frequency
VFR	Visual flight rules

DEFINITIONS

1. ADS-B (Automatic Dependent Surveillance – Broadcast) – Means by which the aircraft, aerodromes and other objects can transmit and7or receive, automatically, data such as identification, position and additional data, as corresponds, as a data link broadcast.

2. **ADS-B in (reception)**: airborne function that receives surveillance data transmitted by the ADS-B OUT functions installed in other aircraft. It could also receive, from the ground, additional data from other aircraft that do not transmit ADS-B OUT or whose ADS-B OUT systems transmit using a different ADS-B technology.

3. **ADS-B out (transmission): F**unction of an aircraft or vehicle that is periodically broadcasting its status vector (position and speed) and other information obtained from airborne systems in a format suitable for ADS-B-IN receivers.

2. **ADS-R (Rebroadcast):** Function of a ground station that permits the interoperability among aircraft equipped with ADS-B systems that operate with different data links. The ADS-R ground station receives ADS-B messages from a link (*e.g.*, UAT), and processes and broadcasts them through a different data link (*e.g.*, 1 090 MHz ES). Docs 9861 and 9871 contain details of TIS-B and ADS-R.

3. **Downlink**: Link associated to signals transmitted over the 1 090 MHz frequency response channel.

4. **Aircraft identification***:* A group of letters, figures, or a combination thereof, which is either identical to, or the coded equivalent of, the aircraft call sign to be used in air-ground communications, and which is used to identify the aircraft in ground-ground or air traffic services communications (*the aircraft identification is frequently known as flight identification).*

5. **Mode S**: Improved mode SSR that permits selective questions and answers. Mode S that permits selective addressing of aircraft using a 24-bit aircraft address that unequivocally identifies each aircraft and has a bidirectional data link between the ground station and the aircraft for the exchange of information.

6. **Mode S SS (Mode S short squitter):** Periodic unsolicited output of a Mode S transponder (nominally once per second) in a specific format to facilitate passive acquisition.

7. **Mode S ES (Mode S extended squitter):** Periodic unsolicited output in a 112-bit 1 090-MHz Mode S signal format containing 56 bits of additional information (*e.g.*, used for ADS-B, TIS-B and ADS-R).

8. **TIS-B:** Broadcast of aircraft surveillance data by ground stations using an ADS-B data link.

9. **TYPES OF ES MESSAGES:**

10.1 AIRBORNE POSITION: The airborne position message provides basic surveillance information, which includes 3-D position, in addition to time of validity and surveillance status information.

10.2 AIRBORNE VELOCITY: The airborne velocity message contains velocity information and other aircraft status data.

10.3 SURFACE POSITION: The surface position message provides the complete surface status vector in a single message.

10.4 AIRCRAFT IDENTIFICATION AND EMITTER CATEGORY: The identification and category squitter provides the aircraft type category as well as the aircraft identification, which corresponds to box 7 of the ICAO flight plan.

10.5 EVENT-DRIVEN: Event-driven squitter is a message transfer protocol for the transmission of additional information that might be occasionally needed.

10. **Uplink:** Link associated to signals transmitted by the 1 030 MHz frequency interrogation channel.

REFERENCE DOCUMENTS

- Doc 4444, Air Traffic Management (PANS-ATM)

- Doc 9924, Aeronautical Surveillance Manual

- Doc 9871, Technical Provisions for Mode S Services and Extended Squitter RTCA/DO-249, DEVELOPMENT AND IMPLEMENTATION PLANNING GUIDE FOR AUTOMATIC DEPENDENT SURVEILLANCE BROADCAST (ADS-B) APPLICATIONS

- RTCA/DO-242, Minimum Aviation System Performance Standards for Automatic Dependent Surveillance – Broadcast (ADS-B)

- RTCA/DO-260B, Minimum Operational Performance Standards for 1090 MHz extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B)RTCA/D0-260 A, Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B)

- RTCA/DO260, Minimum Operational Performance Standards for 1090 MHz Automatic Dependent Surveillance – Broadcast (ADS-B)

- Annex 10, Aeronautical Telecommunications, Volumes 4 and v3,

- SAM Surveillance Strategy Document,

- SAM Performance-Based Air Navigation Implementation Plan (SAM PBIP),

- Global Air Navigation Plan for CNS/ATM Systems (Doc 9750), "Aviation System Block Upgrades (ASBU)" Initiative.

- FAA AC No: 20-165 of 2010.

- EASA Acceptable Means of Compliance - AMC 20-24

1. INTRODUCTION

1.1 Objective

1.1.1 Based on the ATM Operational Concept, the Global Plan, the Regional Plan, and the SAM Performance-Based Plan, it is foreseen that the implementation of the ADS-B system will begin in the medium term.

1.1.2 Likewise, following the guidelines of the Global Plan in its GPI 9, “Situational Awareness”, it was determined that one of the activities of Project “Enhancement of ATM situational awareness” would be the development of this guide, which is intended to serve as a reference for SAM States that need to start operating an ADS-B surveillance system. The guide lists the aspects that must be taken into account before deciding to test and then operate the system.

1.2 Scope of the Guide

1.2.1 This guide is addressed to air navigation service providers, civil aviation authorities, and aircraft operators of the ICAO South American (SAM) Region that need introductory information on technical and operational concepts and issues that should be taken into account before planning and implementing ADS-B as an ATS surveillance sensor or as on-board traffic monitoring system to enhance the situational awareness of the crew. This guide does not replace or supplement the international standards specified by ICAO or other standards developers for the industry, but rather provides a common starting point so that SAM States that are planning to acquire an ADS-B or a new control centre may know what are the performance and technical characteristics that will permit the interoperability of the systems involved.

2. OVERVIEW OF THE ADS-B

2.1 OPERATION OF THE ADS-B

2.1.1 According to Doc 9924 AN/474, Aeronautical Surveillance Manual, ADS-B involves the broadcasting by an aircraft of its position (latitude and longitude), altitude, velocity, identification, and other information obtained from on-board systems. All ADS-B position messages contain data quality indication that allows users to determine if data is good enough to support the function foreseen.

2.1.2 Quality indicators of aircraft position, velocity and other related aircraft data are normally obtained from the airborne GNSS system. Existing inertial sensors alone do not provide the required accuracy or integrity data, although future systems will probably solve this deficiency. Consequently, ADS-B position messages from an inertial system are normally transmitted with a statement of unknown accuracy or integrity. Some new aircraft installations use an integrated GNSS and inertial navigation system to provide position, velocity, and quality indicators for ADS-B transmission.

2.1.3 It is foreseen that these navigation systems will have a better performance than a system based only on GNSS, since inertial and GNSS sensors have supplementary features that mitigate the weaknesses of each system. Since ADS-B messages are broadcast, they may be received and processed in any suitable receiver. This receiver may be an “ADS-B ground station” processing ADS-B messages (extended squitter) and generating aircraft reports to be displayed on an ATCO work console.

2.1.4 Figure 1 below illustrates the operation of ADS-B.

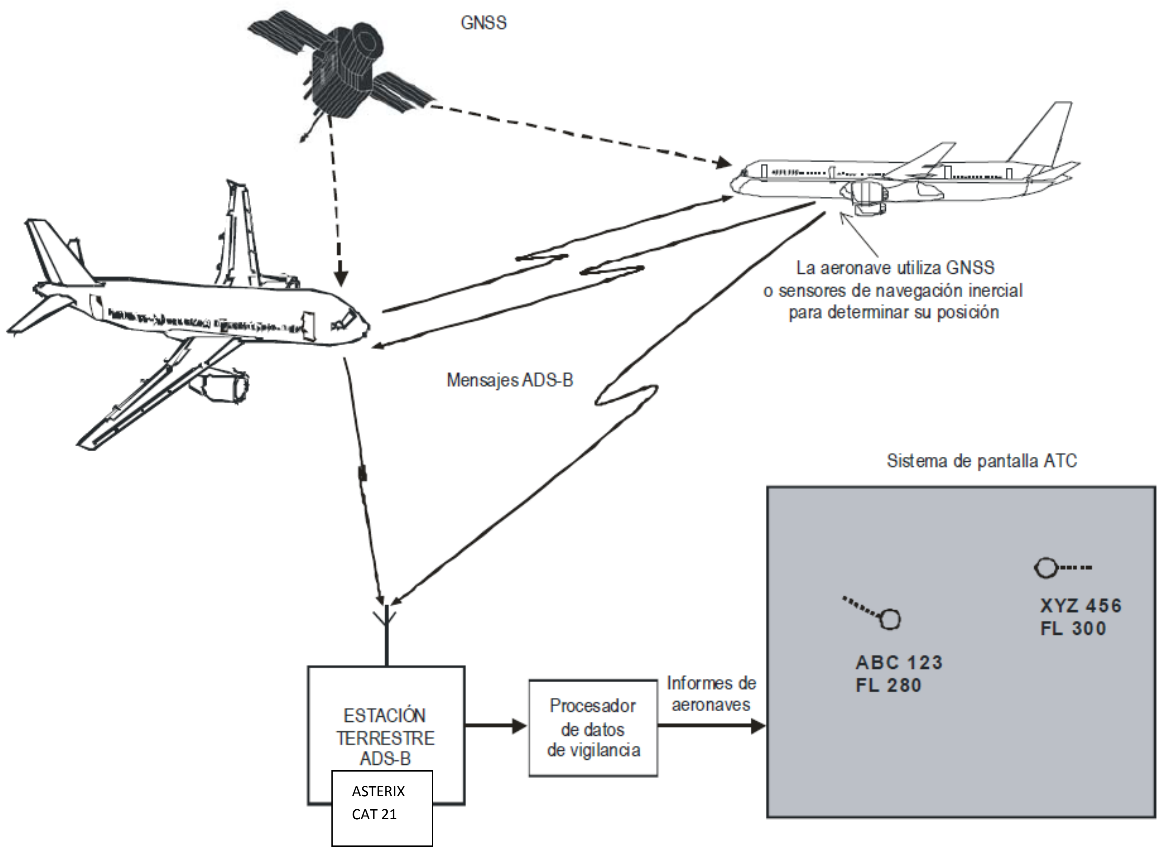


Figure 1: ADS-B schematic

2.1.5 Three ADS-B data links have been developed and standardised for the transport of messages, namely Mode S ES, also known as 1090 ES (Extended Squitter), UAT and VDL Mode 4. Mode S ES has been chosen as the type of link to be used in the SAM Region (GREPECAS Conclusion 12/44 - *Regional CAR/SAM guidance for the introduction of ADS-B data link.* Doc 9871, Technical provisions for Mode S services and extended squitter, provides more details on Mode S ES.

2.1.6 Mode S extended squitter (1090 ES) contains an additional 56-bit data block compared to the conventional Mode S or short squitter (see Figure 2). ADS-B information is broadcast in separate messages, each containing a related data set (*e.g.*, airborne position and pressure altitude, surface position, velocity, aircraft identification and type, emergency information).

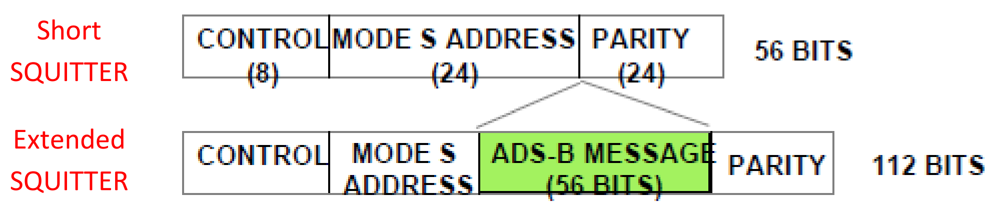


Figure 2. 1 090 ES datagram

2.1.7 The first datagram is the so-called 56-bit Short Squitter (SS), which is transmitted once per second. This short squitter is used for surveillance, where the 24-bit MODE S ADDRESS field embodies the selective interrogation of aircraft addresses consisting of 2 sub-fields, a 9-bit sub-field that identifies the country, and a 15-bit sub-field the identifies the aircraft. Each ES transmission contains the aircraft address, which permits an unequivocal association between the data in the various squitter formats and the originating aircraft.

2.1.8 The second datagram is the 112-bit Extended Squitter (1090 ES) that, in addition to the 56 bits of the SS, contains the 56-bit ADS-B message. There are three standards for the ES: RTCA/DO-260, RTCA/DO-260A and RTCA/DO-260B. these standards correspond, respectively, to Versions 0, 1 and 2, to ICAO Doc 9871.

2.1.8.1 The ES provides five types of reports:

a) Airborne position;
b) Surface position;
c) Aircraft identification and emitter category; and
d) Event-driven.

2.1.8.2 Each of these types is described in Doc 9924 Appendix K item 5 “ADS-B ES messages”. Figures 2A and 2B show examples of ADS-B messages.

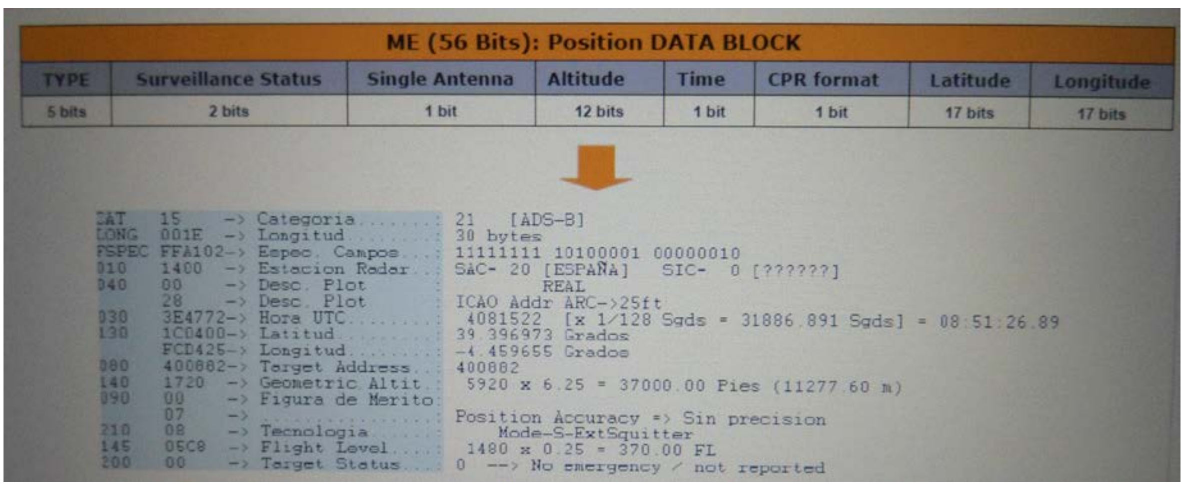


Figure 2A: ADS-B position message

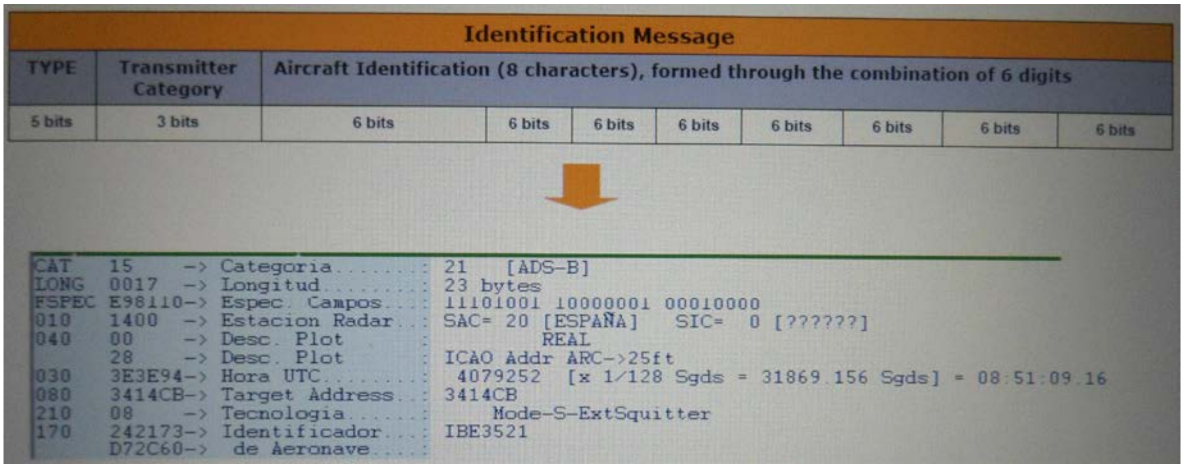


Figure 2B: ADS-B identification message

2.1.9 The initial versions of ES messages are defined in RTCA DO-260 and are known as version ZERO (0) formats. Complete definitions of message structures and data sources for version 0 formats are contained in Doc 9871, Appendix A.
In version 0 formats, the type codes of airborne position and surface position messages can be associated to a navigation uncertainty category (NUC). Version ZERO ES message formats and the associated requirements are suitable for the first implementation stages of extended squitter applications. Surveillance quality is reported in the navigation uncertainty category (NUC), which may be an indication of the accuracy or integrity of the navigation data used for ADS-B. However, it does not specify whether the NUC indicates integrity or accuracy.

2.1.10 The revised versions of ES messages are defined in RTCA DO-260A and RTCA DO-260B known, respectively, as version ONE (1) and versione TWO (2) formats. Complete definitions of the data structure and data sources for versions 1 and 2 formats are contained in Doc 9871, Appendices B and C, respectively. Versions 1 and 2 formats and the associated requirements correspond to more advanced ADS-B applications (see Appendix 1 to this document, "ADS-B operational application").

2.1.11 In the versions 1 and 2, the accuracy and integrity of navigation data are divided into 3 main components, namely NAC, NIC, and SIL (see Appendix 2 to this document, "Introduction of NAC, NIL, and SIL").

2.1.12 Each ES transmission contains a 5-bit field that identifies a "TYPE CODE" specific to each message. Version 0 formats allow the TYPE CODES of airborne position and surface position messages to be associated to a NUC. Version 1 formats allow the TYPE CODES of airborne position and surface position messages to be associated to a NIC.

3. GENERAL CONSIDERATIONS ON ADS-B IMPLEMENTATION PLANNING IN THE SAM REGION

3.1 GENERAL CONSIDERATIONS

3.1.1 As stated in Doc 9924, Aeronautical Surveillance Manual, the following list shows the recommended stages for the planning and implementation of surveillance systems--in this case, of an ADS-B system.

a) *Define the operational requirements*:
- Select the applications to be supported: This will help determine the required performance.
- Define the area of coverage: The definition of the volume where the operational service will be supported is very important since it will serve as a basis for system costing. In particular, the correct identification of lower altitude boundaries is very important sincen it will have significant consequences on the number of sensors to be introduced.
- Define the type of traffic: for example, IFR flights, VFR flights, local or international flights, civil or military flights.

b) *Define the local environment (current and future)*:
- Current and expected traffic densities, including a description of likely peak hours.
- Route structure.
- Type of on-board equipment currently mandatory for the different types of flights (mandatory carriage and actual proportion of equipage).
- Type of aircraft: commercial, general aviation, helicopters, gliders, ultra-light aircraft, VLJ, military aircraft, and their dynamic characteristics (maximum speed, climb speed, turn rate, etc.).
- Segregation of the different types of traffic, possible traffic mix, and likelihood of intrusion of aircraft not equipped with means of cooperative surveillance.
- Specific local RF environment.

c) *Analyse design options and determine the techniques that may be used*:
- Verify existing surveillance sensors that may be reused.
- Verify the new sensors and surveillance techniques that may be introduced at a low cost.
- Determine the number of locations and investigate their availability. Check on-board equipment.
- Determine the required level of redundancy and fall back operating mode.
- Determine whether it will be necessary to carry new equipment on board.
- Determine the impact on operating procedures.
- Conduct cost-benefit and feasibility studies of the different options, if necessary.

d) *Conduct a safety analysis of the new proposed system*:
- To demonstrate that the system will provide the necessary performance in its nominal operating mode.
- To demonstrate that the different failures have been analysed.
- To demonstrate that it was determined that failures were acceptable or could be mitigated.

e) *Implement:*
- If new equipment is required on board, prepare the mandate for on-board carriage;
- The acquisition and installation of the new system.
- The performance assessment of the new system.

f) *Establish the operational service:*
   - Transition from the existing to the new system.

g) *Provide the operational service*:
   - Periodically verify the performance of the new system.
   - Perform regular and preventive maintenance.

3.1.1.1 The following proposals provide practical examples of analyses proposed for the Region, taking into account the participants involved.

3.1.2 **Joint work of the CAA and ANSPs**

3.1.2.1 States should consider the following activities prior to the implementation of an ADS-B surveillance service:

a) Define the operational objective of the implementation.

b) Define the objectives and goals to be achieved in accordance with the national air navigation plan, the ASBU surveillance roadmap and the SAM regional surveillance strategy, for the development of the ADS-B implementation plan, with the participation of aircraft operators and other users involved.

c) Services or areas or flight phases that would be under the planning scope.

d) Analysis of the avionics of the fleet, both Mode-S-equipped and non-equipped, in the airspace concerned; at least the following data should be taken into account:

   - Number of operations or aircraft involved in general aviation, commercial, and military flights. It is recommended that the ratio between the number of aircraft and the operations they conduct be analysed, since, in some cases, commercial aircraft with 1090ES transmission capabilities conduct several operations per day, thus increasing the feasibility of an implementation with a low final cost for aircraft operators.
   - Message standard used for transmission by aircraft (DO-260/DO-260A/DO-260B).

e) ADS-B message standard to be used in the State.

f) Type of application in which ADS-B is to be used in accordance with the requirements and the operational concept (ADS-B-RAD, ADS-B-NRA, ADS-B-APT, ADS-B-ADD, etc.) and the types of transponder that they will require (see Appendix 4).

g) The integration of ES with the SSR system at the existing control centre (if applicable).

h) Advantages, disadvantages, and limitations of the planned implementation.

i) Type of data merging (multi-tracker) of the existing and future SDP serving the ATM automated system.

j) Training of ATCOs and crews on ADS-B, its use, advantages, operational procedures to be used, applicable separation minima, delegation of functions, responsibility limits, etc. Specifically in the case of ATCOs, they shall be warned and trained with respect to the possibility of FLP correlation failures in on-board interfaces due to ACID input errors.

k) Operational risk assessment (in case of failures, navigation data quality degradation, etc.) and ADS-B message performance trials (Doc 4444, 2.6.1.1; 2.6.1.2)

l) Testing and establishment of procedures in case of:

- Contingencies, especially in case of interruption of the receiver autonomous integrity monitoring (RAIM) in accordance with Annex 11, 2.30, and Doc 4444, 8.8.4 and 8.8.5.
- Validation of risk mitigation.
- Independent and joint simulations with pilots.

3.1.3 **Civil aviation authorities (regulatory bodies)**

a) Define the minimum performance and technical/operational characteristics of on-board navigation equipment that will feed ADS-B OUT.

b) Analysis, selection, and validation of quality and integrity parameters in ADS-B message formats in the State.

- Chapters 1, 2, 3 of DO-260A and 2, 3 and 4 of DO242A describe in detail the technical and operational tests and aspects to be taken into account for these processes.

c) Once the testing and parameter selection have been completed, they could be validated as follows:

- The integration of ES with SSR data in a control centre may be a direct way of obtaining ADS-B benefits while maintaining the independence of SSR surveillance. This is based on the use of active interrogation to validate ES surveillance.
- The technique may be used in ground ATC and ACAS surveillance applications. Active surveillance is used for validating the surveillance reported by ADS-B and replacing it if an aircraft loses its navigation capability.
- If the validity check at the beginning of tracking turns out positive, the aircraft may continue in ADS-B with periodic monitoring to ensure the proper continuous operation of the navigation system. If the check turns out negative at any given point in time, tracking can be maintained through active surveillance.

- Another method of validating ADS-B data consists of installing ADS-B with multilateration. The advantage of this option is that it maximises the use of ground infrastructure since multilateration receivers can receive and decode ADS-B messages. This option has the advantage of being completely passive.
- Publication of the respective technical standard as the authority may deem appropriate, highlighting to the ATM community those aspects that crews and aircraft operators (including technical crews on the ground) must take into account when entering data in the on-board interface. (See Appendix 3 – “Proposed publication of a national technical standard.”)
- Drafting of advisory circulars (CA) establishing ADS-B approval requirements for aircraft and operations in the corresponding airspace.

3.1.4 For Operators

a) Equipment with ADS-B message generation and transmission functions. Additionally, for CDTI (Cockpit Display Traffic Information) applications, ADS-B message reception, assembly, and processing functions should be available (in both cases, the data link mode will be ES Mode-S), as well as an appropriate number of interfaces, depending on operational applications, approved by the appropriate ATS authority (see Figure 3).

b) On-board transponders should have the transmission/reception capabilities for the class of transponder (see Appendix 4 “Tables of classes of ADS-B transmitters and receivers”) that corresponds to the ADS-B application to be used, approved by the appropriate ATS authority.

c) The equipment associated to on-board ADS-B may include:

- Secondary sources for navigation data backup and interfaces (for example, redundant GNSS, Loran, FMS / RNAV or INS)
- GNSS augmentation processing
- Interface with applications that support CDTI for visualising other aircraft
- Interface for entering data in the cockpit.

d) Training of crews on ADS-B concepts, the interaction of flight data in ATC applications, the use and procedures of the applications to be used, as well as the contingency plan.

e) Checklists for ADS-B applications to be used, taking into account the importance of correct entry of flight identification in the on-board interface, to be considered for drafting the corresponding technical regulation. Appendix 5, “Aspects to be taken into account by operators when operating an ADS-B transponder”, highlights the importance of this requirement.

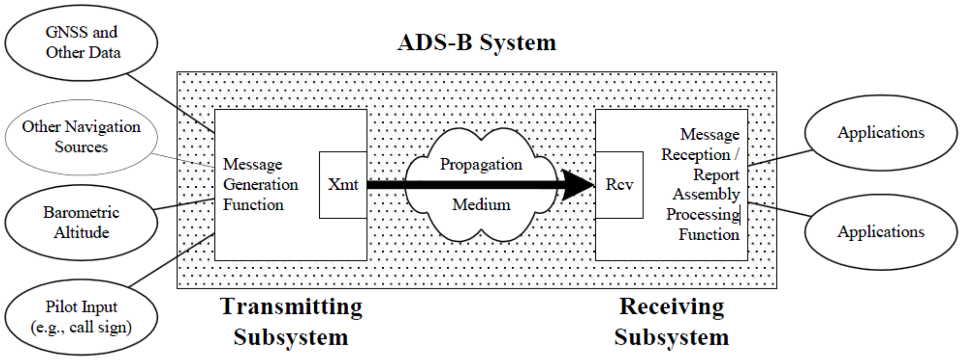


Figure 3: Schematic of ADS-B for operational applications

3.2 ADVANTAGES OF ADS-B

3.2.1 In addition to local, governmental, regional, or global ATM and CNS implementation guides, it is important that the parties responsible for ADS-B implementation planning clearly establish the objectives, advantages, disadvantages, and considerations that this surveillance system entails for the ATM community as a whole, in accordance with it own reality.

3.2.2 In general terms, significant short-, medium-, and long-term safety improvements are achieved (see Appendix 6, “ASBU surveillance methodology roadmap”) both on the ground and on board:

a) Enhanced situational awareness in airspaces with radar surveillance or multilateration, through the provision of more information, between IFR, IFR and VFR flights, between VFR flights with electronic VFR IMC function, between uncontrolled flights, to ATC, etc.
b) Enhanced warning (prediction and resolution) systems both in flight as well as on the ground (between aircraft and between aircraft and ground airport operation vehicles), reducing runway incursions, AIRPROX, ATC safety net warnings, long-term warnings for conflict management, etc.
c) Shorter airborne segments.
d) Reduced ATC workload, enabling the delegation of separation responsibilities to certain flights.
e) Different operational applications and functions using a single system
f) Increased airspace capacity, etc.

3.2.3 Regarding economic benefits, savings can be obtained for:

a) ANSPs: lower cost of installing, maintaining and acquiring an ADS-B antenna versus PSR or MSSR, less logistic problems and architecture complexity if compared to multilateration, for example, for broad area; permits the expansion of ATS surveillance service in low traffic density areas where the installation of radar may not be justified, etc.
b) Air users: cost and fuel savings because it enables more direct and optimum routes, less delays and restrictions (with procedures for delegation of responsibilities and tracking, sequencing, and separation functions), etc.

3.2.4 With respect to safety, ADS-B data may be used also for automated monitoring of resolution advisories (RAs) received from collision avoidance systems (TCAS). This functionality may be an additional benefit for States that implement ADS-B coverage in their areas of responsibility, mainly with respect to safety management systems (SMS), since at present RA assessments are normally done using manual processes based on hazard reports sent to the State by the operators.

3.3 DISADVANTAGES OF ADS-B

3.3.1 ADS-B performance and operation standards are still under development. GPS continues to be the main positioning source, still lacking official backup. The additional use of sensors such as DME-DME, INS, etc. as positioning sources is foreseen.

3.3.1.1 The avionics of the fleet that operates in the SAM Region is not homogeneous, and thus some ES-capable flights transmit messages in version 0 and others in version 1.

3.3.1.2 The cost of acquisition of the equipment required for ADS-B is still high, especially for general aviation, which, in many cases, still lacks the necessary FMC/FMS for data processing. The same happens for the ADS-B IN function.

3.3.1.3 Accordingly, it is likely that exclusive airspaces will need to be implemented in the Region.

3.3.1.4 Most control centres lack the capacity to receive ASTERIX category 21ed. 1.8 data or to process and merge data in accordance with the recommendations proposed in this document for the SAM Region.

3.4 SURVEILLANCE STATUS IN THE SAM REGION

The intentions of the States of the Region regarding ADS-B implementation in each country are summarised below, based on CNS plans submitted by each SAM State to the SAMIG.

3.4.1 Argentina

3.4.1.1 Regarding services under the ICAO CNS/ATM concept, Argentina is planning to borrow one or two ADS-B receiver stations to conduct initial trials in this field.

3.4.1.2 Amongst the improvements to be made to surveillance systems for conventional services, Argentina has foreseen the installation in the short and medium term of MSSR radar systems (INKAN from provider INVAP) as conventional services. Plans concerning the new radars are contained in the guide for the implementation of surveillance systems presented at the sixth meeting of the CNS ATM Subgroup (ATM/CNS/SG/6).

3.4.1.3 Regarding services under the ICAO CNS/ATM concept and, specifically, ADS-B plans for the medium term, Argentina contemplates having a sufficient number of ADS-B receivers, which, in addition to the radars foreseen, would ensure the absence of ¨coverage gaps¨. Information obtained from the receivers and from RSMA radars will be carried over the ATN to the corresponding ACCs.

3.4.2 Bolivia

3.4.2.1 Bolivia has an MSSR located in the Kuturipa hill, within the Cochabamba terminal area.

3.4.2.2 Regarding services under the ICAO CNS/ATM concept, Bolivia has no ADS-B stations and its implementation is under study.

3.4.2.3 Amongst the improvements to be introduced in surveillance systems for conventional services and based on an operational requirement, Bolivia has plans to implement an integrated 4-radar (MSSR) system in the medium term to achieve 80% coverage of the La Paz FIR airspace. Regarding services under the ICAO CNS/ATM concept, Bolivia has plans to continue performing cooperative surveillance, noting that SSR Mode A/C and SSR Mode S will continue to be the main surveillance elements for approach, en route and terminal areas.

3.4.3 **Brazil**

3.4.3.1 During the past years, DECEA has promoted radar modernization programmes, in addition to complementing the coverage with the installation of new stations. The result of these initiatives is that the radar network in Brazil is considerably new and the secondary radar coverage is complete for the whole of the Brazilian territory (over FL250).

3.4.3.2 Due to this infrastructure, the criteria for the application of minimum horizontal separations in the Brazilian airspace is in conformity with ICAO dispositions, varying in accordance with the available ATS surveillance, the structure and the complexity of the airspace where this is applied.

3.4.3.3 Surveillance system implementation plans are contained in FASID Table CNS 4A. The plans for the new surveillance systems are contained in the guide for the implementation of surveillance systems submitted to the sixth meeting of the CNS ATM Subgroup (ATM/CNS/SG/6).

3.4.3.4 Regarding improvements to be introduced in surveillance systems, it may be noted that Brazil is contemplating the replacement of radar sensors of conventional surveillance systems for other radars in the short and medium term. Actions foreseen are contained in Annex J to its Plan.

3.4.3.5 Regarding services under the ICAO CNS/ATM concept, ADS-C service was implemented in the Atlantico FIR in 2009.

3.4.3.6 The high precision and updating rate of the information provided by the ADS-B has the potential to increase safety upon applying aircraft separation at the current environments covered by radars, as well as reduce the great separations applied to aircraft at non-radar environments, whoch installation of this type of surveillance is not justifiable under the cost/benefit point of view.

3.4.3.7 In the short term (2013), ADS-B will be introduced for offshore operations at Bacía de Campos. Likewise, a wide area mutilateration (WAM) system will be implemented at the TMA- VT by 2014.

3.4.3.8 In the medium term, ADS-B implementation all over Brazilian continental airspace will be completed in 2018, followed by the elimination of secondary radar coverage overlaps for en-route operations (this requires users to be duly equipped with ADS-B).

3.4.4 **Chile**

3.4.4.1 Regarding the services under the ICAO CNS/ATM concept, Chile has implemented an ADS-C system at the Oceánico control centre, which is used for flight surveillance in areas under its jurisdiction in the South Pacific.

3.4.4.2 Amongst the improvements to be introduced in surveillance systems for conventional services, Chile has plans to renew its equipment, reinforcing the southern area of the country. Regarding services under the ICAO CNS/ATM concept, and with respect to ADS-B, there are plans to study the possibility of implementing an ADS-B system at some airports of the country.

3.4.5 **Colombia**

3.4.5.1 Regarding services under the ICAO CNS/ATM concept, Colombia has not implemented any ADS-B system.

3.4.5.2 Amongst the improvements to be introduced in surveillance systems for conventional services, Colombia has plans to update its PSR/SSR radar systems and to install a new MSSR radar system at San Andrés in the short term. Regarding services under the ICAO CNS/ATM concept, and with respect to ADS-B, there are plans to expand the MLAT in the medium term to achieve WAM for both terminal area and en route.

3.4.6 **Ecuador**

3.4.6.1 There are 3 radars located in Guayaquil, Quito and Galápagos. Regarding services under the ICAO CNS/ATM concept, Ecuador has no ADS-B or ADS-C system.

3.4.6.2 Amongst the improvements to be introduced in surveillance systems for conventional services, Ecuador has plans to install PSR and MSSR radar systems in the short and medium term, as well as MLAT. The plans for the new radars are contained in the guide for the implementation of surveillance systems submitted to the sixth meeting of the CNS/ATM Subgroup (ATM/CNS/SG/6). Regarding services under the ICAO CNS/ATM concept, and with respect to ADS-B, Ecuador has no implementation project.

3.4.7 **Guyana**

3.4.7.1 Guyana has no radar systems. Its CNS Plan specifies that they will “seek the necessary information for radar data sharing”.

3.4.7.2 In addition, Guyana has scheduled the implementation of and ADS-B system in the short term.

3.4.8 **Paraguay**

3.4.8.1 At national level, Paraguay currently has only one secondary radar Mode S operating in Asunción.

3.4.8.2 Likewise, regarding services under the ICAO CNS/ATM concept, Paraguay foresees that the use of ADS-B in continental area will gradually increase in the air navigation system.

3.4.9 **Peru**

3.4.9.1 At present, Peru has 7 Mode S radar systems at national level, 1 Mode S radar in Lima, and 1 PSR/MSSR radar system in the city of Lima.

3.4.9.2 In 2009, Peru tested an ADS-B station. In the medium term, (2011-2015), there are plans to conduct tests with the ADS-B system, and the first ADS-B stations based on Mode S ES receivers will be implemented at national level. Currently, an ADS-B system has been implemented in Pisco (210 km south of Lima) but has not been commissioned yet. This system would initially be on trial and then integrated into the Lima ACC.

3.4.9.3 In the long term (2015-2025), the existing Mode S SSR radars will not be renewed and will be replaced at the end of their useful life (around 2020) by ADS-B ES systems.

3.4.10 **Suriname**

3.4.10.1 Suriname has no air surveillance systems. Amongst the improvements to be introduced in surveillance systems for conventional services, Suriname is planning to introduce PSR and SSR soon at the Zanderij/J.A.Pengel international airport.

3.4.10.2 Regarding services under the ICAO CNS/ATM concept, Suriname has no plans for their implementation and, thus, does not foresee the implementation of ADS-B.

3.4.11 **Uruguay**

3.4.11.1 Currently, there are 2 radar locations: Carrasco and Durazno.

3.4.11.2 For the time being, there are no plans to implement ADS-B, only ADS-C for the oceanic sector in the next five years. Regarding services under the ICAO CNS/ATM concept, Uruguay has no ADS-B systems.

3.4.11.3 Amongst the improvements to be introduced in surveillance systems for conventional services, Uruguay has plans to replace the system in Carrasco for a new ASR.

3.4.11.4 Regarding services under the ICAO CNS/ATM concept, Uruguay has no plans to implement ADS-B for the time being, only ADS-C for the oceanic sector in the next five years.

3.4.12 **Venezuela**

3.4.12.1 Venezuela has radars, whose location and characteristics are described in the FASID table.

3.4.12.2 Regarding services under the ICAO CNS/ATM concept, and with respect to ADS-B, Venezuela has foreseen its implementation after 2015.

3.4.13 **Summary of the current status in the SAM Region**

Country	**No. of radars**	**Plans to install ADS-B (*)**	**Defined area**
Argentina	12	YES	Radar coverage gaps.
Bolivia	1	NO	N/A
Brazil	75	YES	Bacia de Campos (oil producing area)
Chile	11	YES	Some airports of the country

Country	**No. of radars**	**Plans to install ADS-B (*)**	**Defined area**
Colombia	15	YES	Multilateration (MLAT) to obtain wide area coverage (WAM) with ADS-B functionality at selected airports.
Ecuador	3	NO	N/A
Guyana	0	NO	N/A
Paraguay	1	YES	N/A
Peru	9	YES	Pisco. Radar coverage gaps.
Country	No. of radars	Plans to install ADS-B (*)	Defined area
Suriname	0	NO	N/A
Uruguay	2	NO	N/A
Venezuela	10	YES	After 2015. Not yet defined.

(*) Information obtained from CNS improvement action plans of the States and provided by the States at the SAM/IG/10 meeting. When the State has not specified its plans to implement ADS-B, it is assumed that it has no plans.

3.4.14 Radar coverage diagrams

3.4.14.1 Appendix 7, "SAM radar coverage diagrams" shows the estimated line of sight of the various radar systems in the SAM Region, at 25,000 feet.

3.4.14.2 To calculate coverage, use was made of software that automatically calculates coverage, using NASA SRTM (Shuttle Radar Topography Mission) data as terrain data, considering a radar tower height of 15 m, and also taking into account the curvature of the earth for a flight level of 25,000 feet. Brazil and Colombia provided their respective coverage diagrams.

3.4.14.3 The diagrams show that the area with the least radar surveillance coverage is located in Bolivia, Paraguay and along their boundaries with Argentina, areas in which implementation could start at regional level.

4. CONSIDERATIONS FOR THE INSTALLATION OF AN ADS-B SYSTEM AND THE TRANSFER OF ITS SIGNAL TO AN AUTOMATED CONTROL CENTRE

4.1 General

4.1.1 Although an ADS-B system can be considered as a technology easy to install, it requires consideration of aspects related to electric facilities, air conditioning, and security, just like any other aeronautical facility, except that its requirements will be minimal.

4.1.2 Consequently, it is important to conduct a site study of the facilities before defining where the ADS-B will be installed.

4.1.2.1 This study must cover:

a) Electric supply
b) Civil infrastructure
c) Environmental conditions. Suitable environment in terms of temperature and humidity
d) Security

e) Assessment of electric power characteristics at the site
f) Connectivity platform
g) Analysis of the site, clearway, and cone of silence
h) Radio electric study of the site to avoid possible interference

4.1.3 If all this were available (installed capacity for integrating ADS-B Indoor and Outdoor to the locations), cost savings would be obtained in terms of UPS, power generator, lightning rod, grounding, castle or mast, security system sensors, the security system itself, etc. Likewise, a connectivity platform with the electric characteristics required to link the physical interface of the ADS-B radar data processor with both the system GUI and the control centre to which it is to be integrated will avoid the need to contract media for only the ADS-B service.

4.1.4 System reliability and availability depends on its quality and structure. Consequently, it is advisable to request dual and/or redundant systems. Redundancy is normally provided at the level of processing channels, data transmission networks, safety, etc.

4.1.5 In the specific case of the Peruvian experience with the ADS-B and installed in Pisco, a series of adaptations have been required. To this end, CORPAC (Peru's ANSP) has made available 2 rooms for ADS-B equipment (one for the sensor and the other for the test equipment).

4.1.6 These premises already had in place all the facilities cited in the previous paragraph, except for the means of transportation and management of the ADS-B radar signal up to the Lima ACC, which is its final destination. To that end, CORPAC personnel used the existing REDAP platform, from which 2 terminals from other services had to be withdrawn in order to have sufficient bandwidth to carry the ADS-B signal from Pisco to Lima. We mention this experience as a reference so as not to neglect any aspect when implementing an ADS-B system.

4.2 Typical equipment in an ADS-B OUT ground station

4.2.1 Typically, an ADS-B system consists of the following equipment, materials, and accessories:

a) Antenna array
b) RF receiving equipment (radio frequency)
c) Surveillance data processor
d) Communications unit (link)
e) Networking units (data communications network)
f) GUI and ACC interface unit (in general, the ATS destination unit)
g) Surveillance data display system
h) ADS-B and processed data maintenance, configuration, and administration management system
i) ADS-B test transponder
j) GPS synchronisation unit
k) RF and electric cabling
l) Trays, ducts, conduits, and accessories
m) Grounding points
n) Lightning arrester
o) Uninterruptible power supply - UPS
p) Electric generating set
q) Security system, involving intrusion, overheating, smoke, and fire sensors; video cameras to record indoor and outdoor environment

r) Air-conditioning system (at least air conditioning, humidity control, and dust filters)

s) Static charge prevention or elimination system or materials. Currently, disposable shoe straps are commonly used in electronic environments subject to static damage.

4.3 **Required infrastructure**

4.3.1 **Typical ground infrastructure**

a) Normally, 2 cabinets are required (of a type suited to the physical characteristics of the manufacturer`s equipment) and a castle or mast to install the ADS-B antenna and the lightning arrester system.

Indoors:
Cabinet 1: Contains:
- ADS-B data processor
- Communications unit
- Networking units
- GUI and ACC interface unit (or, in general, the ATS destination unit)

Cabinet 2: Contains:
- Display unit.
- ADS-B and processed data maintenance, configuration, and administration management unit.

Outdoors:
Mast or castle: Contains:
- Antenna
- RF cabling
- Lightning rod, on top of the castle or mast
- Lightning rod power lines

b) The location, at a distance previously determined by the provider of the installation in such a way as to avoid losses from excessive cabling, shall have:

- Lightning rod grounding with resistance values not to exceed 30 ohms
- ADS –B system grounding with resistance values not to exceed 5 ohms

c) Aerial trays are recommended for placing the data cables to connect indoor equipment and to connect indoor to outdoor equipment. Data and electric cabling trays must be different in order to avoid electromagnetic interference that will affect data cabling and thus the ADS-B system.

d) Environmental considerations: Cleaning. Dust is extremely detrimental for the proper operation of equipment; consequently, normal cleaning and general maintenance of the room are essential to avoid problems, especially in connectors and disc units.

e) Interference and disturbances: Different sources may generate interference and/or disturbances. To solve that, there are some products that may be considered.

- Electric discharges: Rugs and low humidity are two main static generators. The equipment should not be installed in rooms with rugs or similar materials, and the humidity range in the room must be controlled. Low humidity is equivalent to static, thus the importance of maintaining humidity within certain ranges. Accordingly, consideration must be given to installing antistatic floors suitable for technical rooms.
- Electromagnetic radiation: Data and electric power cables must run on different trays, maintaining the necessary separation to avoid radiation and interference (needless to say, in case of interference, the data cabling will be the most affected).
- Site assessment: The area to be selected must be as free as possible of obstacles or it must be assured that the terrain model will not be modified in a way that will affect the line of sight of the ADS-B receiver with respect to the air fleet to be served. Likewise, the cone of silence concept must be kept in mind. It is better to foresee a value for the cone of silence than not have any, since, under actual operating conditions, there will be a coverage blind area. Accordingly, a theoretical value between 30 and 90 degrees may be assumed to avoid subsequent surprises.
- Interference to/from other stations: In the ATC environment, SSR, ADS-B, ACAS and military IFF systems use the same frequencies (1 030 MHz and 1 090 MHz) (see Figure 4). Technical and operational changes in one of the aforementioned systems has consequences on the system itself, on the system involved, on other systems operating on the same frequencies, and even on systems that operate on neighbouring frequencies (*e.g.,* DME). The following figure shows 1 030/1 090 MHz systems as part of the 960 MHz–1 215 MHz aeronautical frequency band. Interference may lead to degradation of system performance, with loss of information or erroneous information. Thus, when selecting the site to install ADS-B antennae, consideration must be given to physical and frequency proximity to other navigation systems at the airport, especially DME systems and surveillance radars.

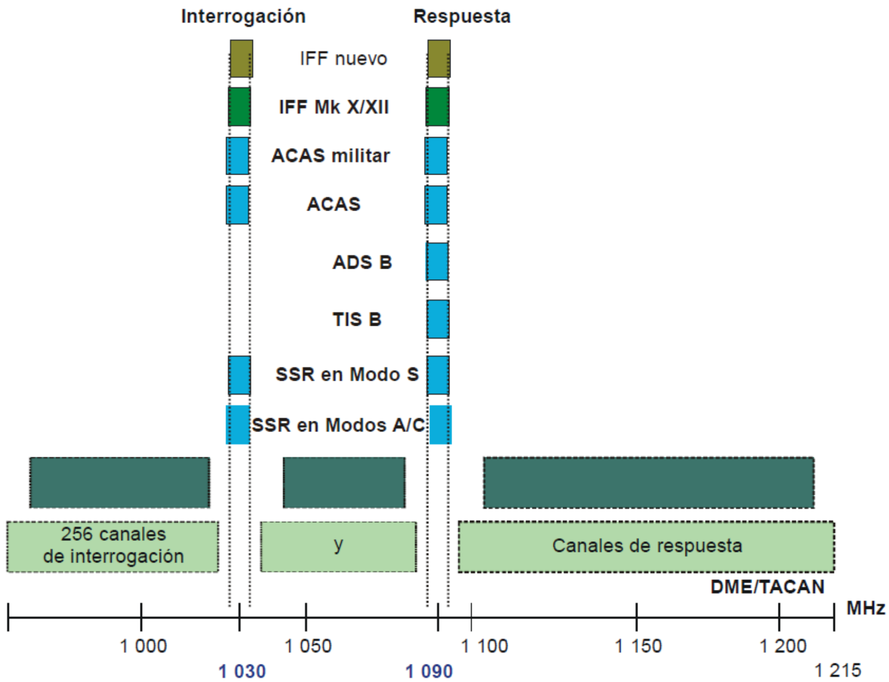


Figure 4. Channels and frequencies in the 960 MHz – 1 215 MHz aeronautical frequency band

f) Temperature: System operation will be more reliable if temperature is kept within a stable range (more conservative than that specified in the manufacturer's manual), the recommendation being between 20º and 25º C. High and unstable work temperatures increase the frequency of circuit failure. However, systems can work for short periods of time at higher or lower temperatures, and it is recommended that ADS-B equipment suppliers be requested to provide the values of the following parameters:

- Operating temperature:
- Minimum temperature:
- Maximum temperature:
- Temperature variations: expressed in T°/ time (° C / hour)
- Instantaneous variations: expressed in T°/ time (° C / minute).

g) Humidity**:** It is recommended that the relative humidity in the rooms selected for the installation be kept between 40% and 60%, with no condensation. Low humidity levels can produce static electricity, while high humidity levels can cause problems in paper feed to printers, as well as fungi problems in magnetic tapes and discs.

The following humidity specifications are recommended:

- Relative air humidity: 40 - 60%, with no condensation.
- Maximum relative humidity: 80%.
- Minimum relative humidity: 30%.

h) Air conditioning: The air conditioning system shall maintain the temperature and humidity of the room within the indicated specifications.

4.3.2 Installation design structure

a) Identification of rooms and sites

Order is important in any facility, even more so in critical systems such as those related to the aeronautical service. Therefore, the establishment of an identification system is the most relevant activity towards the attainment of such order. This will facilitate the task of maintaining and assessing the behaviour of this type of system. It is recommended that system positions be numbered for purposes of identification, giving each system component an identifier, with different prefixes to indicate location, floor, environment, rack, rack level, and the corresponding numbering. Similarly, structured cabling recommendations must be unrestricted. The system supplier must be requested to provide general diagrams of ADS-B connections under the established identification system, as well as of ADS-B LAN cable connections, antennae-rack connections, and connections to the GPS, NTP servers and remote clocks.

b) Identification cabling

- A checklist must be produced with information on point-to-point cable connections.
- Each rack must have a physical list of the cables associated to that rack.
- Likewise, cable labels must contain all the information associated to the rack.
- Each cable contained in the list is identified by a reference number, which is linked to a list of cable suppliers, with manufacturing details concerning signal/names/functions.
- Each label must precisely indicate the beginning and the end of the cable, as well as where should it be connected within the cabling array.

The types of cables normally installed are:

- Radar cabling between the antennae and the filters, between the filters and radar data processors, between processors and the KVM (keyboard, video and mouse), between GPS antennae and processors. To this end, coaxial cables, such as RG-58, RG-214, RG-179, are normally used. Cable gauges will depend on the distance and the technical details of each manufacturer.
- For indoor cables that connect processors to information output interfaces for radar or data display or management, RJ45 Cat 5E is used as a minimum. It would be even better if a superior category of structured cable is used in accordance with standard T568B.

c) Required capacity of the national aeronautical network

- The means of transportation of the signal must take into account the protocols and formats of the radar data provided by the ADS-B.

- Due to the nature of the service, ADS-B data must have an IP medium compatible with the Multicast UDP-type transport level protocol. This usually complicates the link between the ADS-B sensor and the ACC, since public service providers normally use the TCP transport layer protocol for their networks and for providing IP services.
- CORPAC has a frame relay network that has been used to link the ADS-B from Pisco to Lima.

4.4 **Receiver autonomous integrity monitoring (RAIM)**

4.4.1 It is expected that the first ADS-B implementations will use GNSS for positioning. In this regard, since the availability of GNSS data has a direct impact on the provision of surveillance services, ATS service providers can choose to use a GNSS integrity prediction service to help determine the future availability of usable ADS-B data.

4.4.2 The service integrity prediction alerts users to a possible future loss or degradation of the ADS-B service in defined areas. With these alerts, the system is warning users that at some point in the future, ADS-B position data may be insufficient to support the ADS-B separation application.

4.4.3 It is advisable that the prediction service be made available to each ATS unit that uses ADS-B for the provision of separation services, to make sure that air controllers are warned before any foreseen degradation of the GNSS service and the resulting reduced ability to provide flight separation ADS-B within the affected area. This is similar to having advanced warning of a planned interruption of the radar system due to maintenance.

4.4.4 ADS-B must not be used to provide separation between aircraft during the period in which it is expected that the integrity of position reports will not be adequate.

4.4.5 If an unexpected loss of integrity occurs (including a crew RAIM alert report), then:

a) ADS-B separation must not be used by ATC for aircraft until integrity is assured, and

b) The controller must check if other nearby aircraft have filed RAIM alert reports to see if they have been affected and to establish alternative means of separation if necessary.

4.4.6 More information about RAIM can be found in Appendix 8 to this document.

4.5 **Operational tests**

4.5.1 Once the ADS-B system has been installed, a cabling installation certificate must be requested from the manufacturer or responsible company.

4.5.2 The ADS-B transponder testing system will permit the necessary target adjustment in order to achieve optimum signal integrity. This system is referential.

4.5.3 Regarding operational tests, these must start with a physical level link tests and, if successful, continue with UDP multicast traffic transmission tests from the sensor location to the ATS destination unit. For Peru, the test was conduct from Pisco to Lima (REDAP room node-Lima).

4.5.4 If successful, the next tests are to check if the data received is compatible with the application of the air traffic management system provider, which must be capable of processing data in the ASTERIX CAT 21 ed 1.8 protocol.

4.5.5 Regarding the bandwidth of the means of transportation for Lima, the peak is 18 kbps, but this will depend on the number of aircraft with ADS-B avionics that circulate through the airspace to be controlled. The recommended bandwidth for the means of transportation is no less than 64 Kbps.

4.5.6 Flight check tests are an integral part of ground-based ADS-B system testing. The aircraft to be contracted must be properly equipped with 1090 MHz Extended Squitter (1090ES) transponders and recording equipment. Flight routes must be established to test both uplink and downlink services within the defined airspace. More information on flight check testing can be found in Appendix P to Doc 9924 - *Aeronautical Surveillance Manual*.

4.5.7 The information required for assessing the ADS-B system through flight tests must include performance parameters, including minimum ADS-B information update interval, volume of coverage over the geographical area where the ADS-B service is to be provided, radar data accuracy, identification data, maximum data latency, and data validation functions.

4.5.8 An important aspect that must be tested is ADS-B interoperability in the surveillance setting of each State, to ensure that ADS_B will not degrade systems already operating in 1090 MHz. This interoperability with other systems in RF frequencies must be one of the objectives of operational tests.

4.5.9 The flight test methodology can be found in WP ASP12-05-Doc-9924 "Change Proposal for Guidance Material on Flight Testing of New Surveillance Systems".

4.5.10 Another important aspect is the sharing of the means of transportation. Although service integration is what is recommended today, it is important to note that the means should prioritise services. That is, if it is decided that the means of transportation carrying the ADS-B signal will also carry essential services like G/G or G/A speech communications, bandwidth segmentation or assignment techniques should be used to prevent surveillance data information from interfering with speech communications, causing mini voice interruptions (on-line service that admits no delays).

4.6 **Training of technical personnel**

4.6.1 The technical personnel at the sensor site and at the management site of the network that carries the ADS-B signal must be involved in the installation and testing from the beginning. Likewise, they must receive training on the structure of the system, operating characteristics and conditions, radar signal flow, and every technical detail that allows the system to operate under the foreseen nominal conditions.

4.6.2 At the network management site, the bandwidth used for the ADS-B system multicast traffic must be monitored, and the respective changes of processing channels must be coordinated, if applicable, with the resident technician in case remote management or other type of activity is not available.

4.6.3 A final recommendation is that personnel in charge must at all times remember that if the ranges and data specified by the system manufacturer are disregarded, the useful life of the equipment will be degraded and, consequently, reliability will be lost.

4.6.4 The ADS-B system model presented below (Figure 5) may serve as a reference.

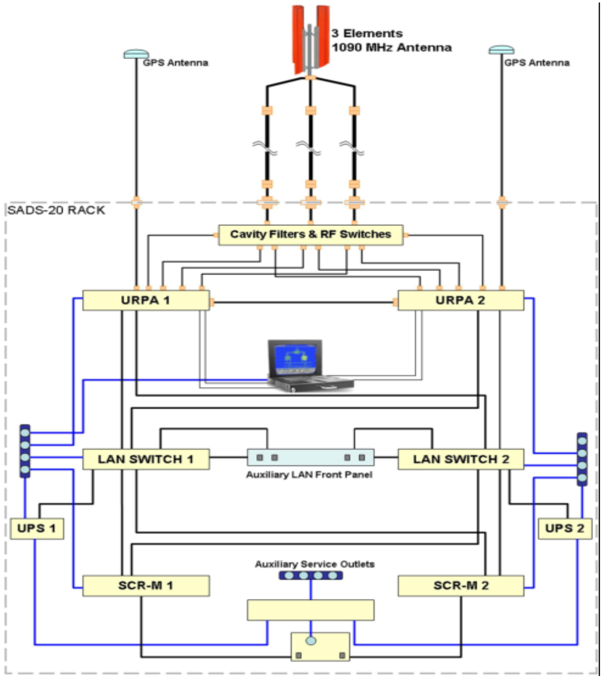


Figure 5: ADS-B Architecture Model

<u>The arquitecture is composed by the following elements:</u>

- Antenna set:
    - Three independent sectors

- Distribution of RF signals:
    - Set of radio frequency filters and relays

- ADS-B processing receiver unit (APRU):
    - 3 1090-MHz receiver cards
    - 3 processing cards
    - 1 GPS synchronisation card
    - 1 software card (Linux OS)

- Local management system (local control and monitoring))
    - Based on the Unix system
    - System capable of integration with the APRU or any other equipment.

- Communication system:
    - Two (2) redundant LAN networks
    - Routers

5. FUNCTIONAL RECOMMENDATIONS FOR AUTOMATED AIR TRAFFIC MANAGEMENT SYSTEMS TO BE USED WITH ADS-B IN THE SAM REGION

5.1 In order to achieve a common interoperability standard for the use of ADS-B in the SAM Region, in addition to that provided for in Chapter 8.2 of Doc 4444, automated air traffic management systems used by ANSPs should have at least the following technical and operational characteristics:

a) If navigation information is degraded according to the appropriate State ATS authority, the control centre should be able to determine when the reported accuracy and integrity values are sufficient to support a given application (*e.g.*, control with ATC surveillance for 5NM separation). Consequently, it should be capable of entering the allowable information quality and integration (NUC, NIC/NAC/SIL) threshold values that correspond to the ADS-B message version. States should be able to configure these parameters without the intervention of the provider.

Note: Reference: Doc 4444 Chapter 8.1.10 and, for more details about these concepts and ES performance, see document DO-260A Chapters 2, 3 and 4.

b) Appropriate visual alarm display at the ASD in case of deterioration of the minimum value(s) entered as per paragraph a) above, so that ATS units may distinguish between a radar blip, a multilateration blip, and an ADS-B blip (or a combination of these) beyond the limits established for providing separation in the airspace concerned (ref. Doc 4444 Chapter 8.2.5).

c) For the purpose of analysis and study by the States, it is recommended that automated systems maintain ADS-B plot generation capability, even beyond the established limits mentioned in paragraph "a" above, for non-operational display (technical monitoring). However, these out-of-limit plots should not be taken into account by the multi-tracker for merging with data from other sensors.

d) Information displayed on the ASD about the type of surveillance sensor used (whether one or several sensors), so as to identify each combination.

e) Performance of the information on the corresponding parameters received in ADS-B messages (ADS-B-ADD) concerning the safety nets processed by the surveillance system SDP or FDP, as appropriate (see Appendix 1, "ADS-B operational applications").

f) Processing of ASTERIX Category 21 edition 1.8 messages (Appendix 9 "Asterix Category 21 Ed. 1.8")

g) Capability of processing "version 0" and "version 1" ADS-B messages simultaneously (ICAO Annex 10, Volume 4, item 5.2.4).

APPENDIX 1 - ADS-B OPERATIONAL APPLICATIONS

In general terms, in order to take advantage of the amount and types of data provided by ADS-B, the following are considered as possible operational applications:

1. CDTI (Cockpit Display of Traffic Information)
2. Airborne collision avoidance
    a. Enhancements to existing airborne collision avoidance systems
    b. ACAS based on ADS-B
3. Conflict management and airspace conflict resolution
    a. Airborne conflict management and airspace conflict resolution
    b. ATS surveillance and conflict management
4. ATS conformity monitoring
    a. Successive approaches
    b. Incursion processes (special use airspace, restricted airspace, bad weather area hazardous for flights, runways and taxiways, controlled lighting area (under ATS control), areas with weight and wing span limitations, and other operational control areas, such as noise-sensitive areas.
5. Enhanced search and rescue
6. Enhanced tracking between flights
7. Light operations and control
8. Operational requirements of airport ground vehicles and aircraft rescue and fire fighting vehicles (ARFF)
9. Performance measurements for maintaining altitude/height
10. Control of general aviation operations

    Note: For more details about these recommended applications and requirements, see Appendix D and E to document DO-242A.

The SAM surveillance strategy includes the implementation of ADS-B Package I, consisting of a set of ground-based surveillance applications, improved situational awareness of traffic, and on-board delegation of spacing.

ADS-B Package I ground surveillance applications seek to improve ATC surveillance en route, in the TMA, and on the airport surface, and to improve ATC tools through the provision of aircraft-derived data *via* ADS-B. These applications are:

- ADS-B-RAD ATC surveillance of TMA and en-route airspace in areas already covered by radar systems
- ADS-B-NRA ATC surveillance of non radar areas
- ADS-B-APT surveillance of the airport surface
- ADS-B-ADD data derived from the aircraft for ATC tools

ADS-B Package I on-board surveillance applications seek to improve on-board surveillance (cockpit) of en-route and TMA airspace and airport surface.

These applications are:

- ATSA-SURF Improved situational awareness of traffic on the airport surface
- ATSA-VSA Improved visual separation during approach
- ATSA-ITP Wake procedure in oceanic airspace
- ATSA-AIRB Improved situational awareness of traffic during flight operations

Note: States that will implement these functions should take into account Chapter 5 of Annex 10 v4, as well as DO-260A, Chapter 2.1.11 and 2.1.12 (for quick reference, Annex A with the tables of these 2 chapters is attached to this document)

ADS-B Package I on-board spacing applications seek to use on-board surveillance capabilities (cockpit) to run applications whereby the crew can maintain a given time and distance from designated aircraft. These applications are:

- ASPA-S&M Improved sequencing and merging operations
- ASPA-C&P Improved crossing and passing operations

APPENDIX 2 – INTRODUCTION OF NAC, NIL, SIL

2.2.1 Surveillance accuracy and integrity are reported separately as navigation accuracy category (NAC), navigation integrity category (NIC) and surveillance integrity level (SIL).

2.2.2 ES version 1 formats also include provisions on improved status information reporting. Amongst other aircraft parameters, the operational status message contains the version number of the ADS-B transmitter equipment, the SIL parameter, and the navigation accuracy category for position (NAC_P).

2.2.3 Version 1 formats allow type codes of flight position messages and surface position messages to be associated with a NIC.

2.2.4 The NIC is reported in such a way that surveillance applications can determine if the reported geometric position has an acceptable level of integrity for the use foreseen. The NIC parameter specifies an integrity containment radius (Rc). In this regard, document DO242A describes the close relationship between the NIC value and the SIL and the Rc.

2.2.5 The SIL parameter acts together with the NIC parameter, and specifies the probability of the actual position being outside of the containment radius without any alerts being activated.

2.2.6 The NAC_P parameter is reported in such a way that surveillance applications can determine if the reported geometric position has an acceptable level of accuracy for the use foreseen.

2.2.7 Document DO-242A, amongst other notes contained in table 2-3, specifies that:

2.2.7.1 The EPU – (Estimated Position Uncertainty) corresponds to a 95% accuracy bound on horizontal position. The EPU is defined as the radius of a circle, centred on the reported position, such that the probability of the actual position being outside the circle is 0,05. When reported by a GPS or GNSS system, the EPU is commonly called HFOM (horizontal figure of merit).

2.2.7.2 The NIC and NAC_p currently used in DO242A replaced the NUC_p of the previous version of the MASPS.

2.2.7.3 RNP accuracy includes other sources of error aside from the sensor, while the horizontal error for NAC_P only refers to the certainty of the horizontal position error.

Table 2-3: Navigation Accuracy Categories for Position (NAC_P).

NAC_P	95% Horizontal and Vertical Accuracy Bounds (EPU and VEPU)	Comment	Notes
0	EPU ≥ 18.52 km (10 NM)	Unknown accuracy	
1	EPU < 18.52 km (10 NM)	RNP-10 accuracy	1
2	EPU < 7.408 km (4 NM)	RNP-4 accuracy	1
3	EPU < 3.704 km (2 NM)	RNP-2 accuracy	1
4	EPU < 1852 m (1NM)	RNP-1 accuracy	1
5	EPU < 926 m (0.5 NM)	RNP-0.5 accuracy	1
6	EPU < 555.6 m (0.3 NM)	RNP-0.3 accuracy	1
7	EPU < 185.2 m (0.1 NM)	RNP-0.1 accuracy	1
8	EPU < 92.6 m (0.05 NM)	e.g., GPS (with SA)	1
9	EPU < 30 m and VEPU < 45 m	e.g., GPS (SA off)	2
10	EPU < 10 m and VEPU < 15 m	e.g., WAAS	2
11	EPU < 3 m and VEPU < 4 m	e.g., LAAS	2

2.2.8 SIL information will be even more important when the position of the aircraft is determined by an on-board system that combines GNSS and INS and other navigation sources, such as DME-DME, to which end the aircraft should transmit the highest SIL that position sensors can support, so that it can be used in more demanding applications.

Note: DO-242A elaborates on this point with a note on SIL and the following table: *"It is assumed that SIL is a static (unchanging) value that depends on the position sensor being used. Thus, for example, if an ADS-B participant reports a NIC code of 0 because four or fewer satellites are available for a GPS fix, there would be no need to change the SIL code until a different navigation source were selected for the positions being reported in the SV report."*

SIL	Probability of Exceeding the R_C Integrity Containment Radius Without Detection	Comment
0	Unknown	"No Hazard Level" Navigation Source
1	1×10^{-3} per flight hour or per operation	"Minor Hazard Level" Navigation Source
2	1×10^{-5} per flight hour or per operation	"Major Hazard Level" Navigation Source
3	1×10^{-7} per flight hour or per operation	"Severe Major Hazard Level" Navigation Source

Note: It is important that, for final implementation reference, States use the values in this table, together with the appropriate NAC and NIC values, as specified in the MASPS, MOPS and Annex 10.

2.2.9 If a State is planning to use the TIS-B (Traffic Information System - Broadcast) based on SSR/MSSR for relaying information, the SIL could change depending on different considerations, such as the individual characteristics of the sensors used, whether the targets are captured by one sensor or a combination of sensors, coverage, the multi-track system used, etc. (see Chapter 5 of Annex 10 v.4, Appendix 1 to this document, and DO-260A)

2.2.10 States shall take into account that DO-260A, in Chapter 2.2.3.2.7.2.6, specifies that the NIC reported in "status reports" or SV is not explicitly transmitted in the ADS-B message, since it is 1 bit of the sub-field ("ME" bit 44, Message bit 76), but rather must be determined from "TYPE CODES". The NIC supplement could be used to distinguish between 2 very close Rc values. Table 2-70 of that same document, shown below, lists NIC code types.

Table 2-70: Navigation Integrity Category (NIC) Encoding.

NIC Value	Containment Radius (R_C) and Vertical Protection Limit (VPL)	Airborne		Surface	
		Airborne Position TYPE Code	NIC Supplement Code	Surface Position TYPE Code	NIC Supplement Code
0	R_C unknown	0, 18 or 22	0	0, 8	0
1	R_C < 20 NM (37.04 km)	17	0	N/A	N/A
2	R_C < 8 NM (14.816 km)	16	0	N/A	N/A
3	R_C < 4 NM (7.408 km)	16	1	N/A	N/A
4	R_C < 2 NM (3.704 km)	15	0	N/A	N/A
5	R_C < 1 NM (1852 m)	14	0	N/A	N/A
6	R_C < 0.6 NM (1111.2 m)	13	1	N/A	N/A
	R_C < 0.5 NM (926 m)	13	0		
7	R_C < 0.2 NM (370.4 m)	12	0	N/A	N/A
8	R_C < 0.1 NM (185.2 m)	11	0	7	0
9	R_C < 75m *and* VPL < 112 m	11	1	7	1
10	R_C < 25m *and* VPL < 37.5 m	10 or 21	0	6	0
11	R_C < 7.5m *and* VPL < 11 m	9 or 20	0	5	0

Note: *"N/A" means "This NIC value is not available in the ADS-B Surface Position Message formats."*

2.2.11 Following the analysis that States must conduct of the NIC, NAC, SIL, it is expected that official values will be published in accordance with the ADS-B applications being considered. The following table shows an example of these values, which by no means should be considered as the actual values.

Application	NAC	NIC	SIL
ATC service with 5NM separation	6	8	2
ATC service with 3NM separation	5	7	2
FIS – without separation service	3	5	1

Note: FAA AC No: 20-165 of 2010 contains a sample guide for airworthiness approval of airborne ADS-B OUT equipment.
EASA documentation (AMC 20-24) can also be used as a reference for an NRA environment.

APPENDIX 3 - "PROPOSAL OF PUBLICATION OF A NATIONAL TECHNICAL STANDARD"

Example of a technical standard on the use of ADS-B for crews and technical personnel:

1. For aircraft with MODE-S transponders (1090/1090ES)

1.1 At present, ATS surveillance systems used in the State have 2 ways of automatically associating the FPLs to the aircraft identified by MSSR and ADS-B sensors, namely:

i. Mode A transponders
ii. Mode S transponders (1090/1090ES)

1.2 Crews using aircraft with Mode A transponders shall continue activating them, in accordance with the regulations and norms in force.

1.3 Crews using aircraft with Mode S/ADS-B OUT transponders (1090/1090ES) shall take into account the following:

1.3.1 The flight identification shall be correctly entered in the airborne data entry interface (CDTI, FMS, etc.), just as it was entered in box 7 of the FPL. Some airborne interfaces do not permit the change of flight ID after take-off, so it is recommended that special care be taken when using and entering information on this equipment.

1.3.2 The flight identification shall consist of the 3-letter designator of the company according to ICAO Doc 8585 and the flight number. In no case shall the IATA coding be used. If the flight number is not available (*e.g.,* private aircraft, general aviation, or aircraft to be moving only on the ground), the aircraft registration number shall be entered or, if an FPL has been filed, the identification specified in box 7 thereof.

1.3.3 Aircraft within ADS-B coverage (250 NM around the SCO VOR) shall keep the GNSS receiver on at all times; otherwise, the flight information in the ATC surveillance systems will be lost. If any contingency arises that forces the crew to turn off the GNSS receiver, the crew shall immediately report the occurrence to the corresponding ATC unit.

APPENDIX 4 – TABLES OF AIRBORNE AND GROUND ADS-B TRANSMITTER AND RECEIVER CLASSES

Table 2-1: ADS-B Aircraft System Classes (adapted from RTCA DO-242A, Table 3-1)

Class	Subsystem	Example Applications	Features	Comments
Interactive Aircraft/Vehicle Participant Systems (Class A)				
A0	Minimum Interactive Aircraft/Vehicle	Enhanced Visual Acquisition, conflict detection	Lower transmit power and less sensitive receive than Class A1.	Minimum interactive capability with CDTI.
A1	Basic Interactive Aircraft	A0 Plus Airborne Conflict Management, station keeping	Standard transmit power and more sensitive receiver. Antenna Diversity (Note)	Provides ADS-B based conflict avoidance and interface to current TCAS surveillance algorithms/displays.
A2	Enhanced Interactive Aircraft	A1 Plus merging, conflict management, in-trail climb	Standard transmit power and more sensitive receiver. Interface with avionics source required for aircraft trajectory intent data. Antenna Diversity (Note)	Baseline for separation management employing intent information.
A3	Extended Interactive Aircraft	A2 Plus long range conflict management	More sensitive receiver. Interface with avionics source required for aircraft trajectory intent data. Antenna Diversity (Note)	Extends planning horizon for strategic separation employing intent information.
Broadcast-Only Participant Systems (Class B)				
B0	Aircraft Broadcast Only	Supports enhanced visual acquisition and conflict detection.	Transmit power may be matched to coverage needs. Nav data input required.	Enables aircraft to be seen by Class A and Class C users.
B1	Aircraft Broadcast Only	Supports B0 applications plus airborne conflict management and station keeping.	Transmit power may be matched to coverage needs. Nav data input required. Antenna Diversity (Note)	Enables aircraft to be seen by Class A and Class C users.
B2	Ground Vehicle Broadcast Only	Supports visual acquisition and conflict avoidance on airport surface.	Transmit power matched to surface coverage needs. High accuracy Nav data input required.	Enables vehicle to be seen by Class A and Class C users.
B3	Fixed Obstacle	Supports visual acquisition and conflict avoidance.	Fixed coordinates. No Nav data input required. Collocation with obstacle not required with appropriate broadcast coverage.	Enables Nav hazard to be detected by Class A users.
Ground Receive Systems (Class C)				
C1	ATS En Route and Terminal Area Operations	Supports ATS cooperative surveillance.	Requires ATS certification and interface to ATS sensor fusion system.	En Route coverage out to 200 NM. Terminal coverage out to 60 NM
C2	ATS Parallel Runway and Surface Operation	Supports ATS cooperative surveillance.	Requires ATS certification and interface to ATS sensor fusion system.	Expected approach coverage out to 30 NM, or the point where the aircraft intercepts the final approach course. Surface coverage out to 5 NM
C3	Flight Following Surveillance	Supports private user operations planning and flight following.	Does not require ATS interface. Certification requirements determined by user application.	Coverage determined by application.

Notes:

1. *See §3.3.1 for Antenna Diversity.*
2. *All ADS-B Class A, B0 and B1 systems are also intended to support the Air-to-Ground ATC Surveillance applications.*

Table 2-3: ADS-B Class A Transmitter Equipment To Message Coverage

Transmitter Class	Minimum Transmit Power (at Antenna Port)	Example Operation	MASPS Requirement (RTCA DO-242A)	Minimum Message Capability Required (From Table 2-2)
A0 (Minimum)	70 W	• Aid to Visual Acquisition • Conflict Avoidance	SV MS	Airborne Position A/C Identification & Type Airborne Velocity A/C Operational Status Extended Squitter A/C Status
		• Airport Surface	SV MS	Surface Position A/C Identification & Type A/C Operational Status Extended Squitter A/C Status
A1 (Basic)	125 W	• Aid to Visual Acquisition • Conflict Avoidance • Simultaneous Approaches	SV MS	Airborne Position A/C Identification & Type Airborne Velocity A/C Operational Status Extended Squitter A/C Status
		• Airport Surface	SV MS	Surface Position A/C Identification & Type A/C Operational Status Extended Squitter A/C Status
A2 (Enhanced)	125 W	• Aid to Visual Acquisition • Conflict Avoidance • Separation Assurance and Sequencing • Flight Path Deconfliction Planning • Simultaneous Approaches	SV MS TS TC+0	Airborne Position A/C Identification & Type Airborne Velocity A/C Operational Status Extended Squitter A/C Status Target State and Status Reserved for TC Message
		• Airport Surface	SV MS	Surface Position A/C Identification & Type A/C Operational Status Extended Squitter A/C Status
A3 (Extended)	125 W	• Aid to Visual Acquisition • Conflict Avoidance • Separation Assurance and Sequencing • Flight Path Deconfliction Planning • Simultaneous Approaches	SV MS TS TC+n	Airborne Position A/C Identification & Type Airborne Velocity A/C Operational Status Extended Squitter A/C Status Target State and Status Reserved for TC Message
		• Airport Surface	SV MS	Surface Position A/C Identification & Type A/C Operational Status Extended Squitter A/C Status

<u>Table 2-4:</u> ADS-B Class B Transmitter Equipment To Message Coverage

Transmitter Class	Minimum Transmit Power (at Antenna Port)	Example Operation	MASPS Requirement (RTCA DO-242A)	Minimum Message Capability Required (From Table 2-2)
B0 (Aircraft)	70 W [1]	• Aid to Visual Acquisition • Conflict Avoidance	SV MS	Airborne Position A/C Identification & Type Airborne Velocity A/C Operational Status Extended Squitter A/C Status
		• Airport Surface		Surface Position A/C ID and Type A/C Operational Status Extended Squitter A/C Status
B1 (Aircraft)	125 W [1]	• Aid to Visual Acquisition • Conflict Avoidance	SV MS	Airborne Position A/C Identification & Type Airborne Velocity A/C Operational Status Extended Squitter A/C Status
		• Airport Surface		Surface Position A/C Identification and Type A/C Operational Status Extended Squitter A/C Status
B2 (Ground Vehicle)	70 W [1]	• Aid to Visual Acquisition • Conflict Avoidance • Airport Surface	SV MS	Surface Position A/C Identification & Type A/C Operational Status
B3 (Fixed Obstacle)	70 W [1]	• Aid to Visual Acquisition • Conflict Avoidance • Airport Surface	SV MS	Airborne Position A/C Identification & Type A/C Operational Status

[1] – May be increased based upon application specific needs.

<u>Notes:</u> *(Table 2-3 and Table 2-4):*

1. *SV = State Vector, MS = Mode Status, TS = Target State, TC = Trajectory Change*
2. *SV elements are specified in <u>Table 2-81</u>.*
3. *MS elements are specified in <u>Table 2-88</u>.*

Table 2-5: ADS-B Class A Receiver Equipment To Report Coverage

Receiver Class	Minimum Trigger Threshold Level (MTL)	Reception Technique	Example Operation	MASPS Requirement [RTCA DO-242A Table 3-3(a)]	Minimum Report Required
A0 (Basic VFR)	-72 dBm	Standard	• Aid to Visual Acquisition • Airport Surface	SV MS	ADS-B State Vector Report (§2.2.8.1) AND ADS-B Mode Status Report (§2.2.8.2)
A1 (Basic IFR)	-79 dBm	Enhanced (§2.2.4.4)	• Aid to Visual Acquisition • Conflict Avoidance • Simultaneous Approaches • Airport Surface	SV MS ARV	ADS-B State Vector Report (§2.2.8.1) AND ADS-B Mode Status Report (§2.2.8.2) AND ADS-B Air Referenced Velocity Report (ARV) (§2.2.8.3.2)
A2 (Enhanced IFR)	-79 dBm	Enhanced (§2.2.4.4)	• Aid to Visual Acquisition • Conflict Avoidance • Separation Assurance and Sequencing • Simultaneous Approaches • Airport Surface	SV MS TS ARV TC+0	ADS-B State Vector Report (§2.2.8.1) AND ADS-B Mode Status Report (§2.2.8.2) AND ADS-B Target State Report (§2.2.8.3.1) AND ADS-B ARV Report (§2.2.8.3.2) AND Reserved for ADS-B Trajectory Change Reports
A3 (Extended Capability)	-84 dBm	Enhanced (§2.2.4.4)	• Aid to Visual Acquisition • Conflict Avoidance • Separation Assurance and Sequencing • Flight Path Deconfliction Planning • Simultaneous Approaches • Airport Surface	SV MS TS ARV TC+n	ADS-B State Vector Report (§2.2.8.1) AND ADS-B Mode Status Report (§2.2.8.2) AND ADS-B Target State Report (§2.2.8.3.1) AND ADS-B ARV Report (§2.2.8.3.2) AND Reserved for ADS-B Trajectory Change Reports

Table 2-6: ADS-B Class C Receiver Equipment To Report Coverage

Receiver Class	Minimum Trigger Threshold Level (MTL)	Operation	MASPS Requirement [RTCA DO-242A Table 3-3(b)]	Minimum Report Required
C1 (ATS En Route and Terminal)	Not Specified in these MOPS	• Aid to Visual Acquisition • Conflict Avoidance • Separation Assurance and Sequencing • Flight Path Deconfliction Planning	SV MS TS ARV TC+n	ADS-B State Vector Report (§2.2.8.1) AND ADS-B Mode Status Report (§2.2.8.2) AND ADS-B Target State Report (§2.2.8.3) AND ADS-B ARV Report (§2.2.8.3.2) AND Reserved for ADS-B Trajectory Change Report(s)
C2 (Approach and Surface)	Not Specified in these MOPS	• Aid to Visual Acquisition • Conflict Avoidance • Separation Assurance and Sequencing • Simultaneous Approaches • Airport Surface	SV MS TS ARV TC+n	ADS-B State Vector Report (§2.2.8.1) AND ADS-B Mode Status Report (§2.2.8.2) AND ADS-B Target State Report (§2.2.8.3.1) AND ADS-B ARV Report (§2.2.8.3.2) AND Reserved for ADS-B Trajectory Change Report(s)
C3 (Flight Following)	Not Specified in these MOPS	• Aid to Visual Acquisition • Separation Assurance and Sequencing • Airport Surface	SV MS	ADS-B State Vector Report (§2.2.8.1) AND ADS-B Mode Status Report (§2.2.8.2)

Note: *(Table 2-5 and Table 2-6):*

SV = State Vector, MS = Mode Status, OC = On-Condition TS = Target State, ARV = Air Referenced Velocity, TC = Trajectory Change

APPENDIX 5 – ASPECTS THAT OPERATORS SHOULD TAKE INTO ACCOUNT WHEN OPERATING AN ADS-B TRANSPONDER

- In the early stages of these implementations, crews normally incur in frequent errors when entering the flight/aircraft identification or ACID (aircraft ID) in the airborne interface. Both the ELS and ES (1090 ES) functions of the Mode S transponder emit the flight identification information entered on board. This identification should be the same as the one shown in box 7 of the ICAO flight plan. This same data, when transmitted, is called “target identification” (or “tid”) with the data reference number of I021/170 of the ASTERIX protocol, category 21, in the message formats processed by the control centre.

- For aircraft privately operated, the flight ACID should reflect the aircraft registration (*e.g.*, OB123G). In this case, consideration should be given to physical coding of the flight identification (on the same transponder, for example, during initial installation), with the corresponding registration number, to avoid the need for an input interface in the cockpit and to ensure the integrity of the information. The coding of the flight identification should be checked during installation and initial testing.

- When the flight ACID changes (*e.g.*, airline operations), an interface to enter the flight ACID will be required in the cockpit. In this case, the flight identification should be the ICAO 3-letter airline designator, followed by the flight number. The input interface should be checked to ensure proper flight ACID coding during installation and initial testing.

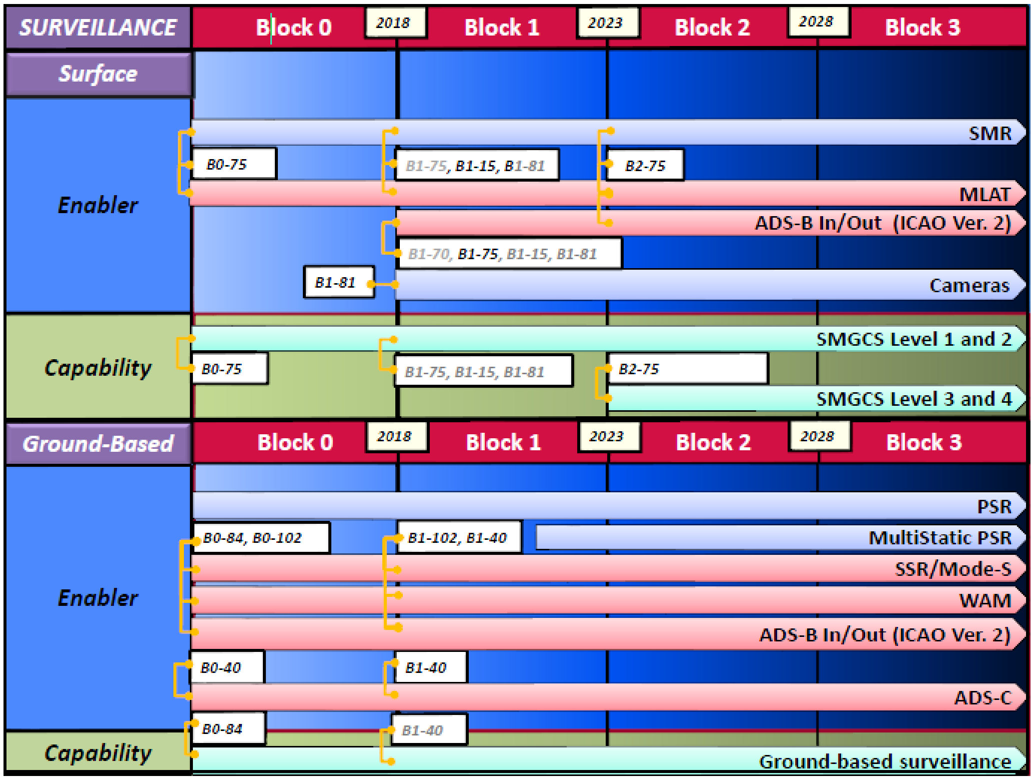
- It has been noted that some aircraft models have an ACID blocking system in the airborne interface to avoid changes to the flight identification.

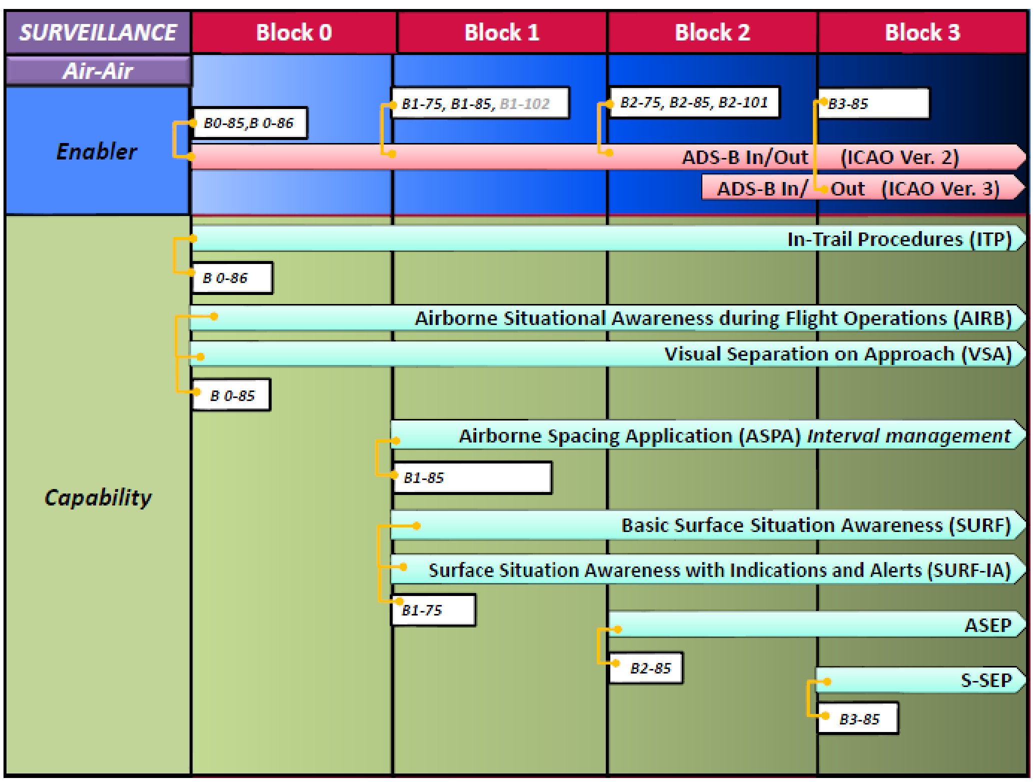
- This setup, sometimes known as WOW (Weight On Wheels), shall be taken into account by operators and ANSPs to alert crews about on-board interface operation, so as to reduce the problems they cause to the ATC system. It is recommended that straightforward operation manuals and checklists be produced on this topic, especially during implementation phases.

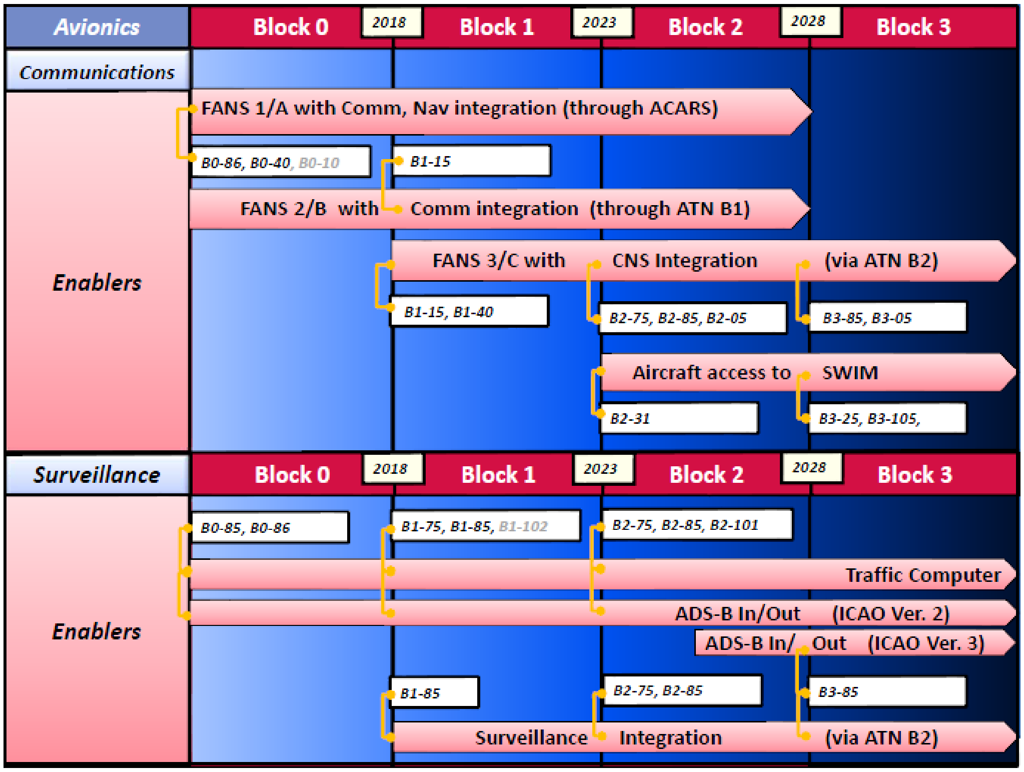
- Some problems caused by flights with incorrect ACIDs are: inability to automatically correlate flight plans with ADS-B blips, correlation with an incorrect FPL, increased controller workload and thus reduced ATC capacity, unforeseen delays, frequency saturation, failure to process prediction or MTCD alerts, etc.

- It is expected that, during the initial ADS-B implementation phases, crew workload will increase upon ensuring entry of the right data, since they will be using different identifications (*e.g.*, ICAO-IATA) at different points in time.

APPENDIX 6 – ASBU METHODOLOGY SURVEILLANCE "ROADMAP"



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Block 0
2018
Block 1
2023
Block 2
2028
Block 3
Communications
Enablers
FANS 1/A with Comm, Nav integration (through ACARS)
B0-86, B0-40, B0-10
B1-15
FANS 2/B with Comm integration (through ATN B1)
FANS 3/C with CNS Integration (via ATN B2)
B1-15, B1-40
B2-75, B2-85, B2-05
B3-85, B3-05
Aircraft access to SWIM
B2-31
B3-25, B3-105,
Surveillance
B0-85, B0-86
B1-75, B1-85, B1-102
B2-75, B2-85, B2-101
Traffic Computer
ADS-B In/Out (ICAO Ver. 2)
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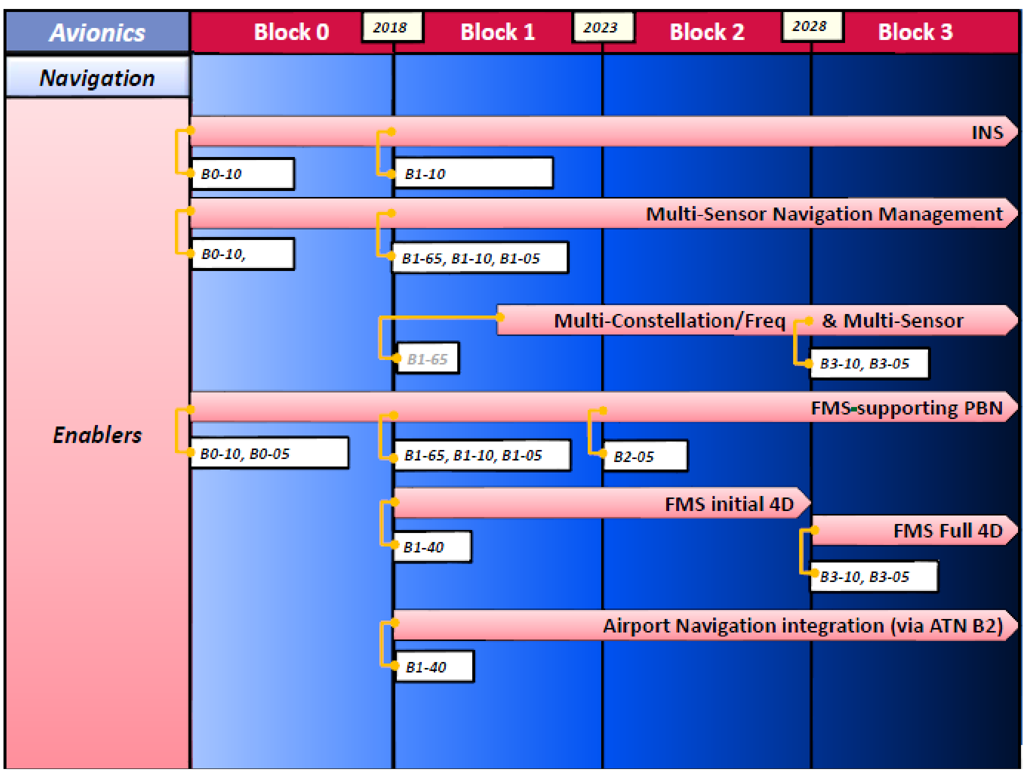
B1-85
B2-75, B2-85
B3-85
Surveillance Integration (via ATN B2)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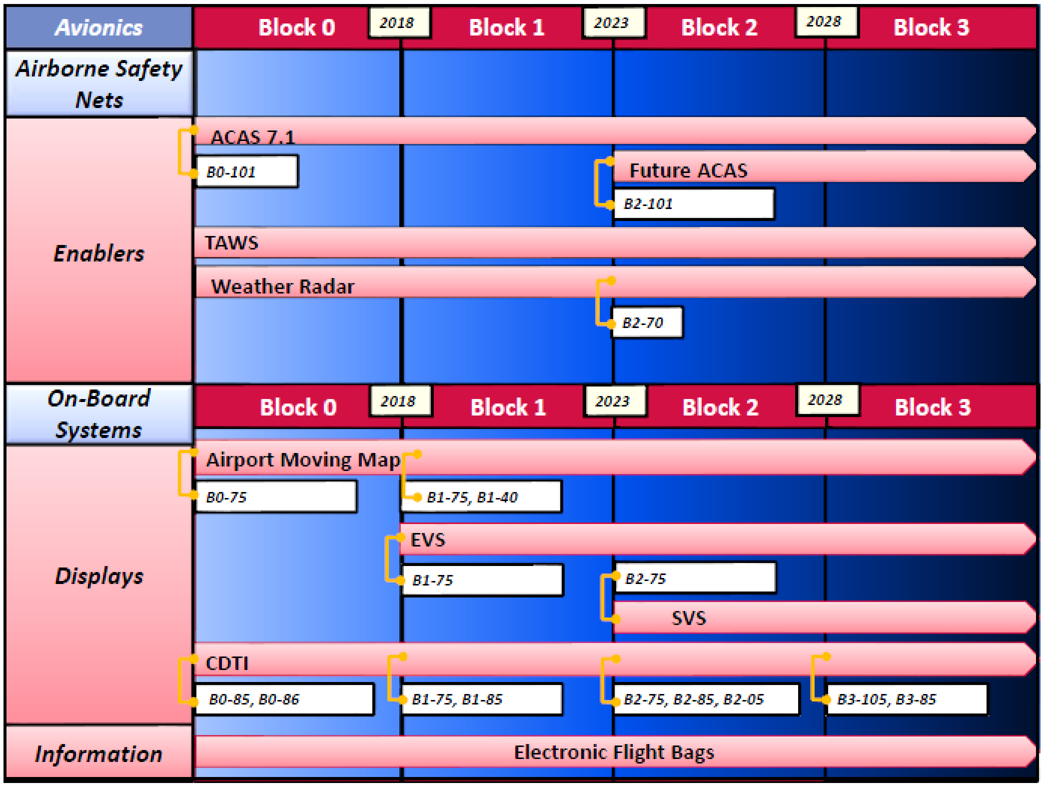
Block 1
2023
Block 2
2028
Block 3
Navigation
Enablers
INS
B0-10
B1-10
Multi-Sensor Navigation Management
B0-10,
B1-65, B1-10, B1-05
Multi-Constellation/Freq & Multi-Sensor
B1-65
B3-10, B3-05
FMS-supporting PBN
B0-10, B0-05
B1-65, B1-10, B1-05
B2-05
FMS initial 4D
FMS Full 4D
B1-40
B3-10, B3-05
Airport Navigation integration (via ATN B2)
B1-40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Enablers
ACAS 7.1
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Future ACAS
B2-101
TAWS
Weather Radar
B2-70
On-Board Systems
Block 0
2018
Block 1
2023
Block 2
2028
Block 3
Displays
Airport Moving Map
B0-75
B1-75, B1-40
EVS
B1-75
B2-75
SVS
CDTI
B0-85, B0-86
B1-75, B1-85
B2-75, B2-85, B2-05
B3-105, B3-85
Information
Electronic Flight Bags

APPENDIX 7 – SAM RADAR COVERAGE DIAGRAMS

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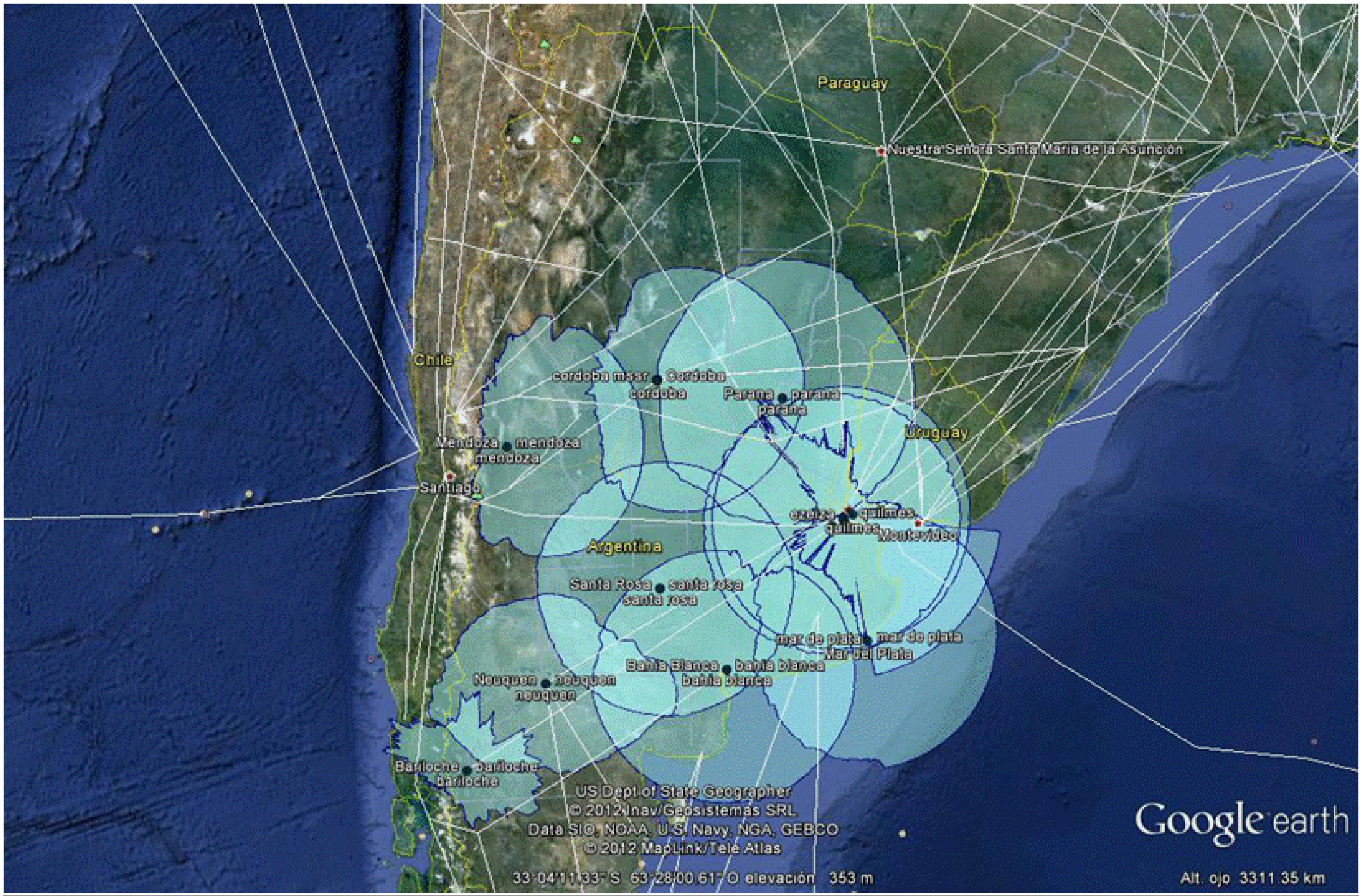

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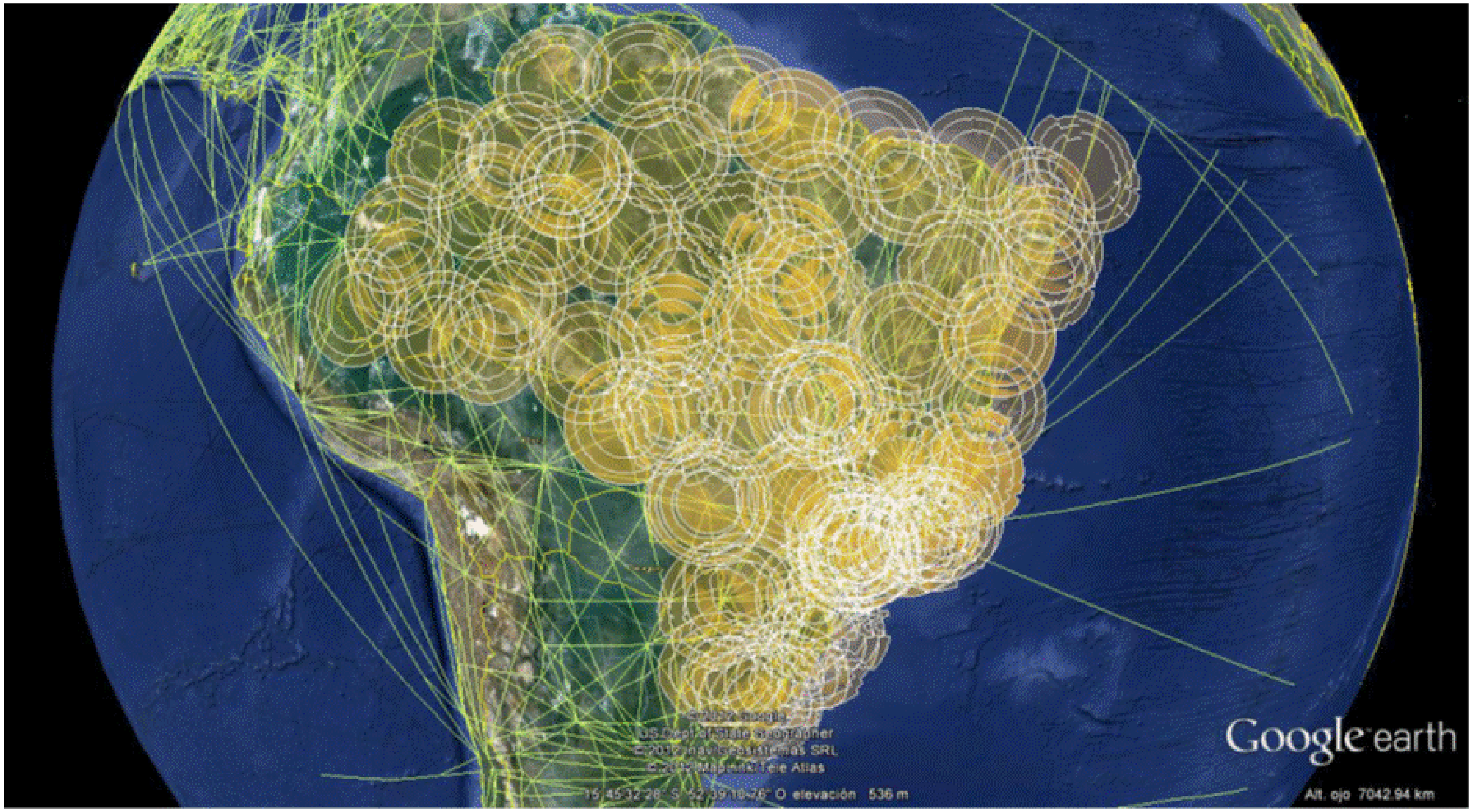

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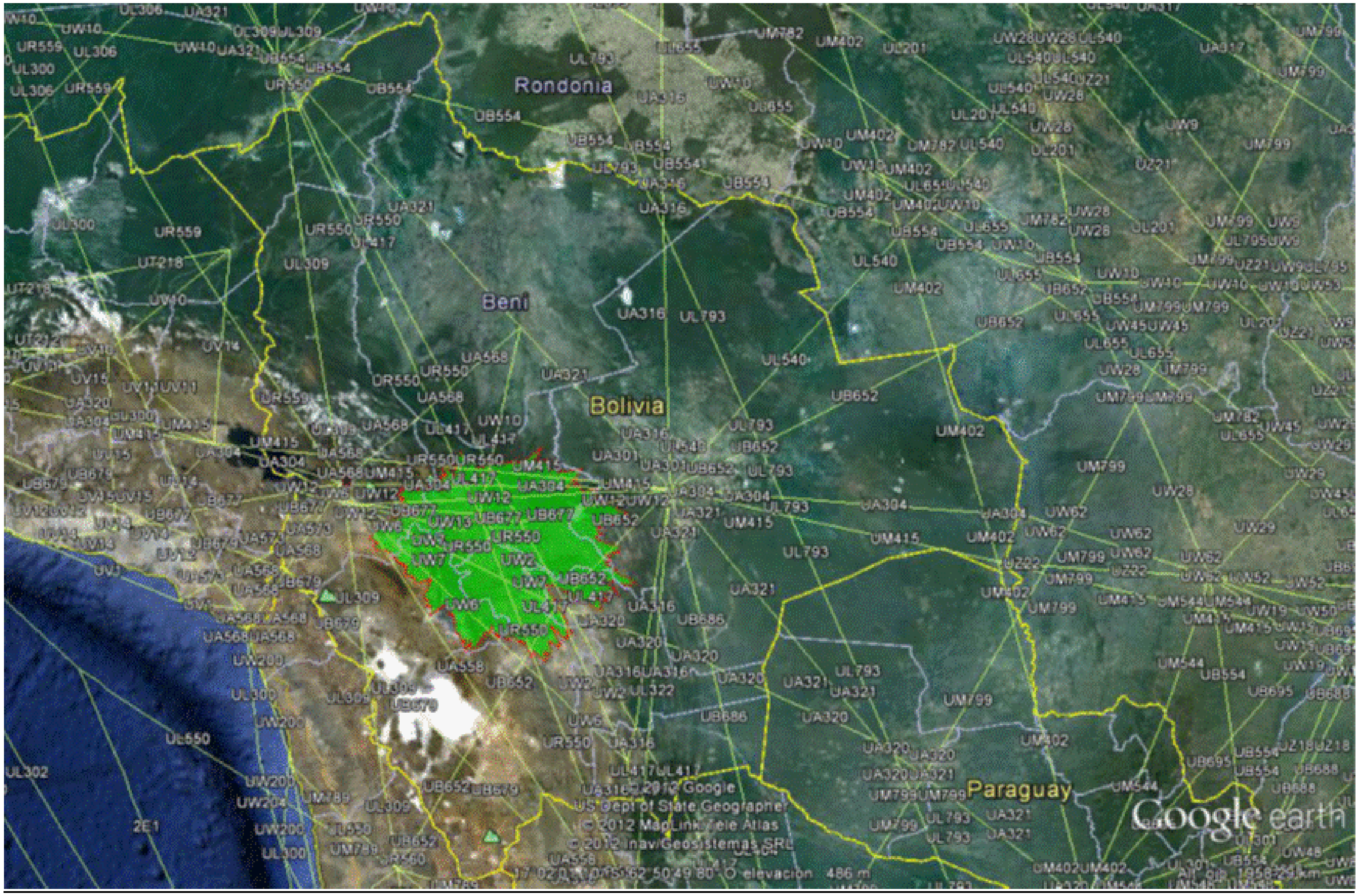

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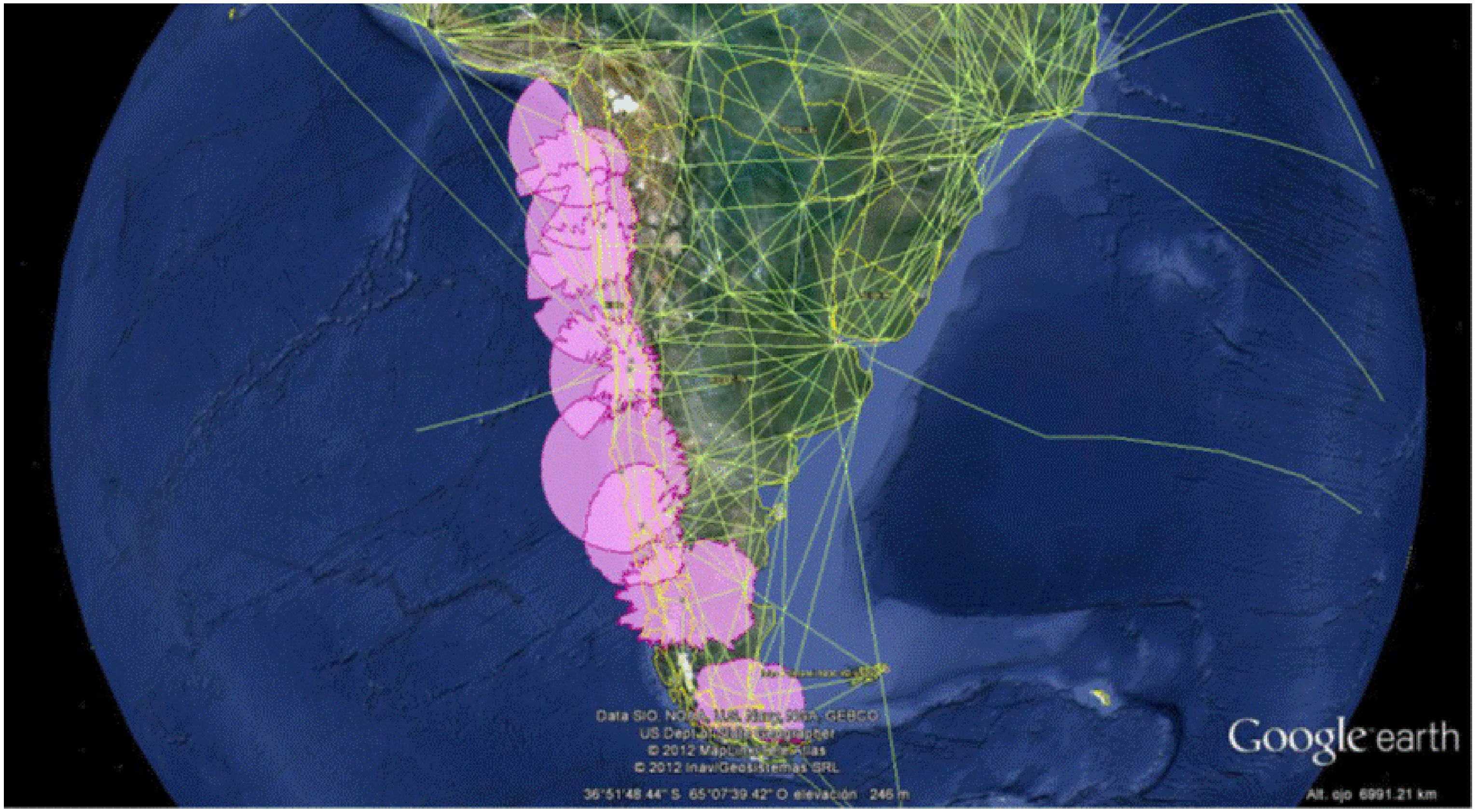
© 2012 Inav/Geosistemas SRL
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Google earth
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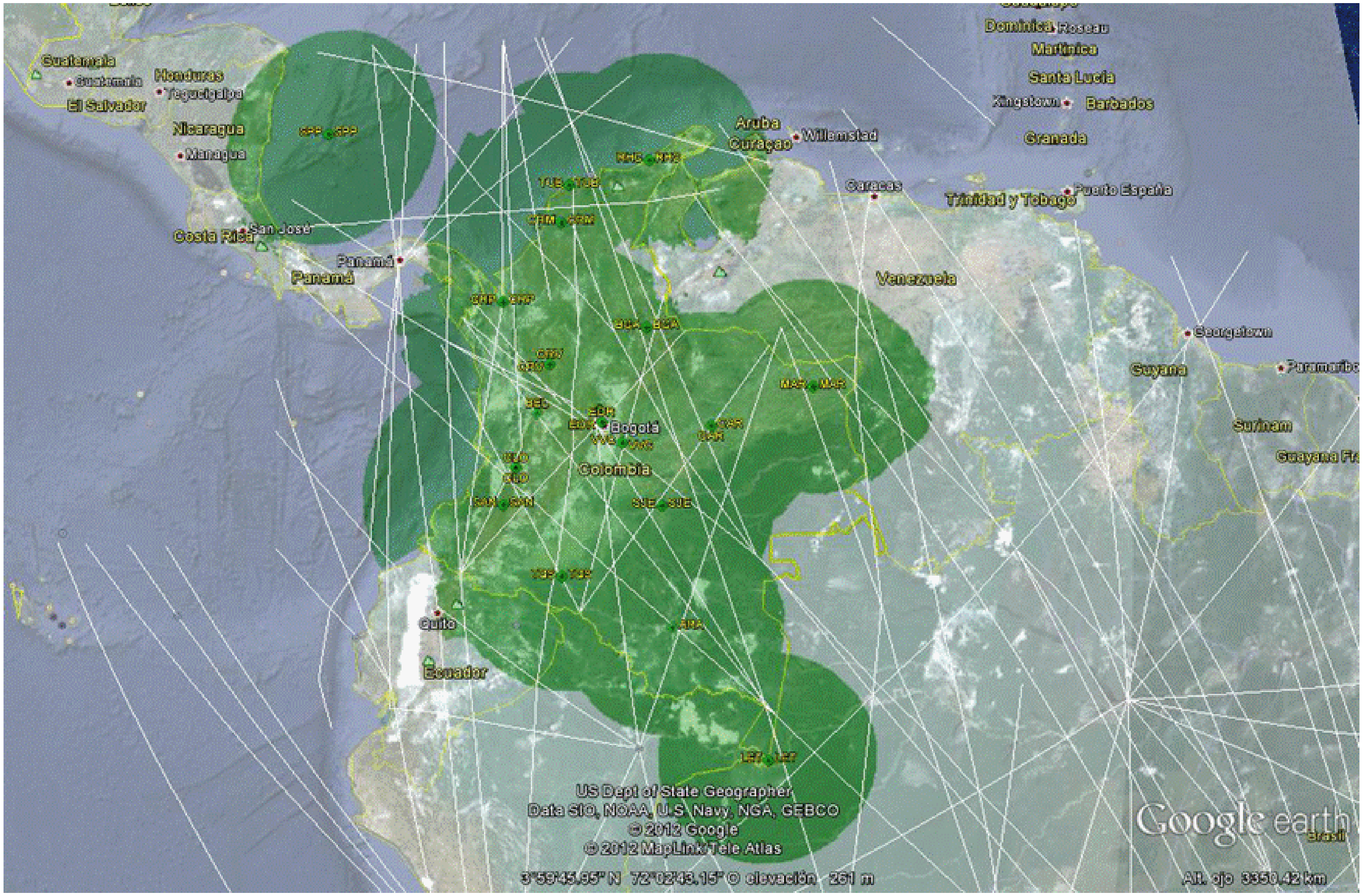

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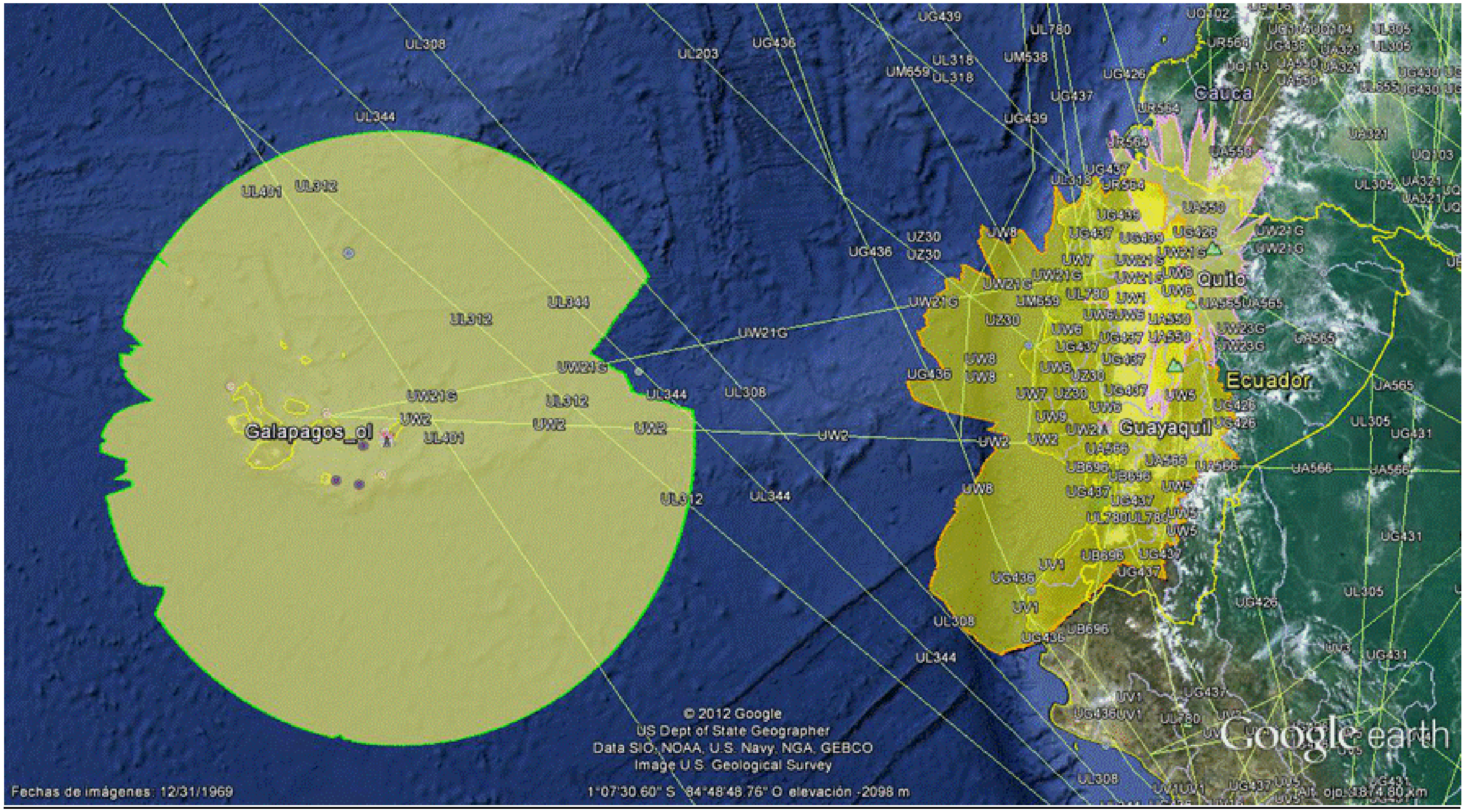

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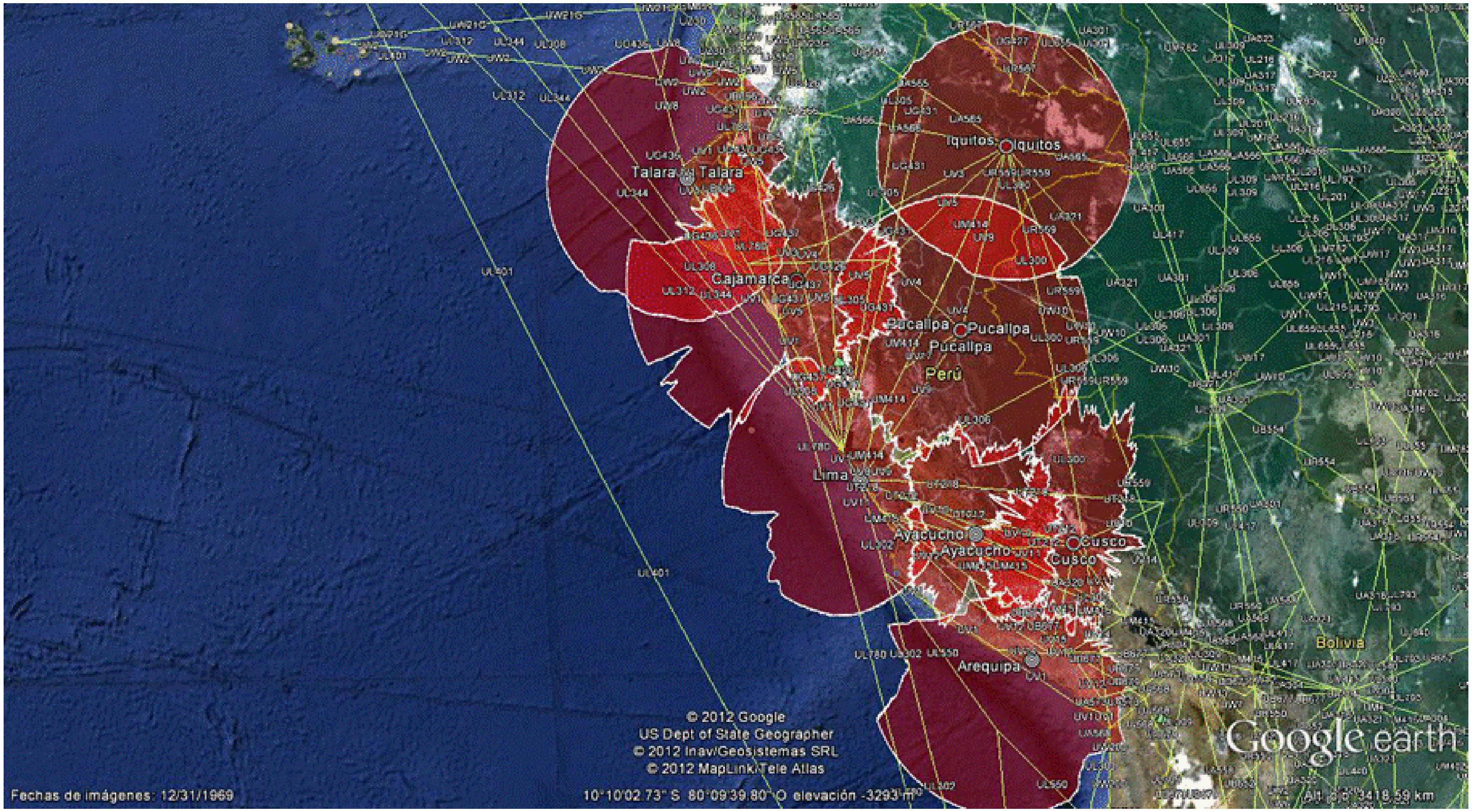
Iquitos
Talara
Cajamarca
Pucallpa
Perú
Lima
Ayacucho
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© 2012 Google
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© 2012 MapLink/Tele Atlas
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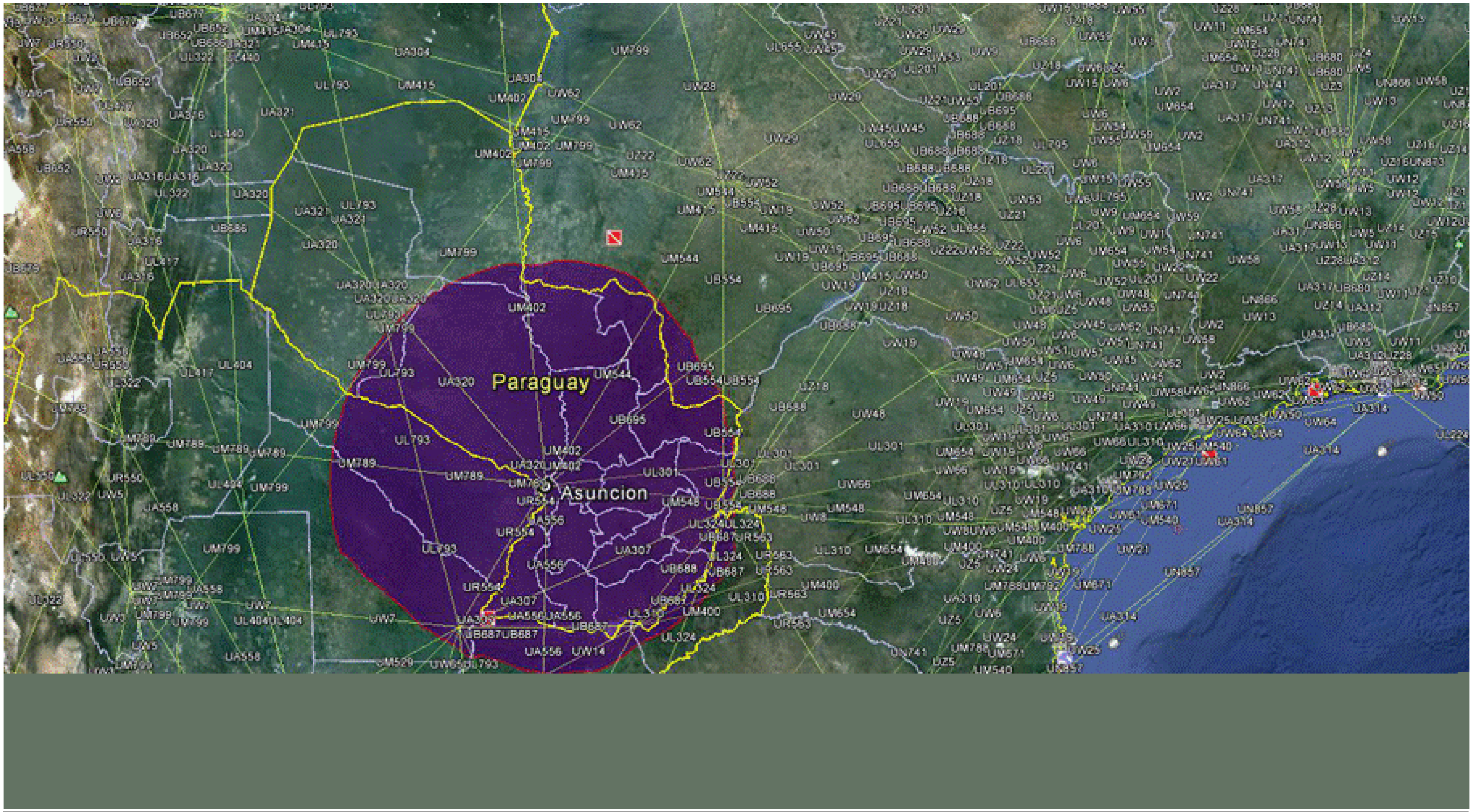
Fechas de imágenes: 12/31/1969

PARAGUAY (FL250)



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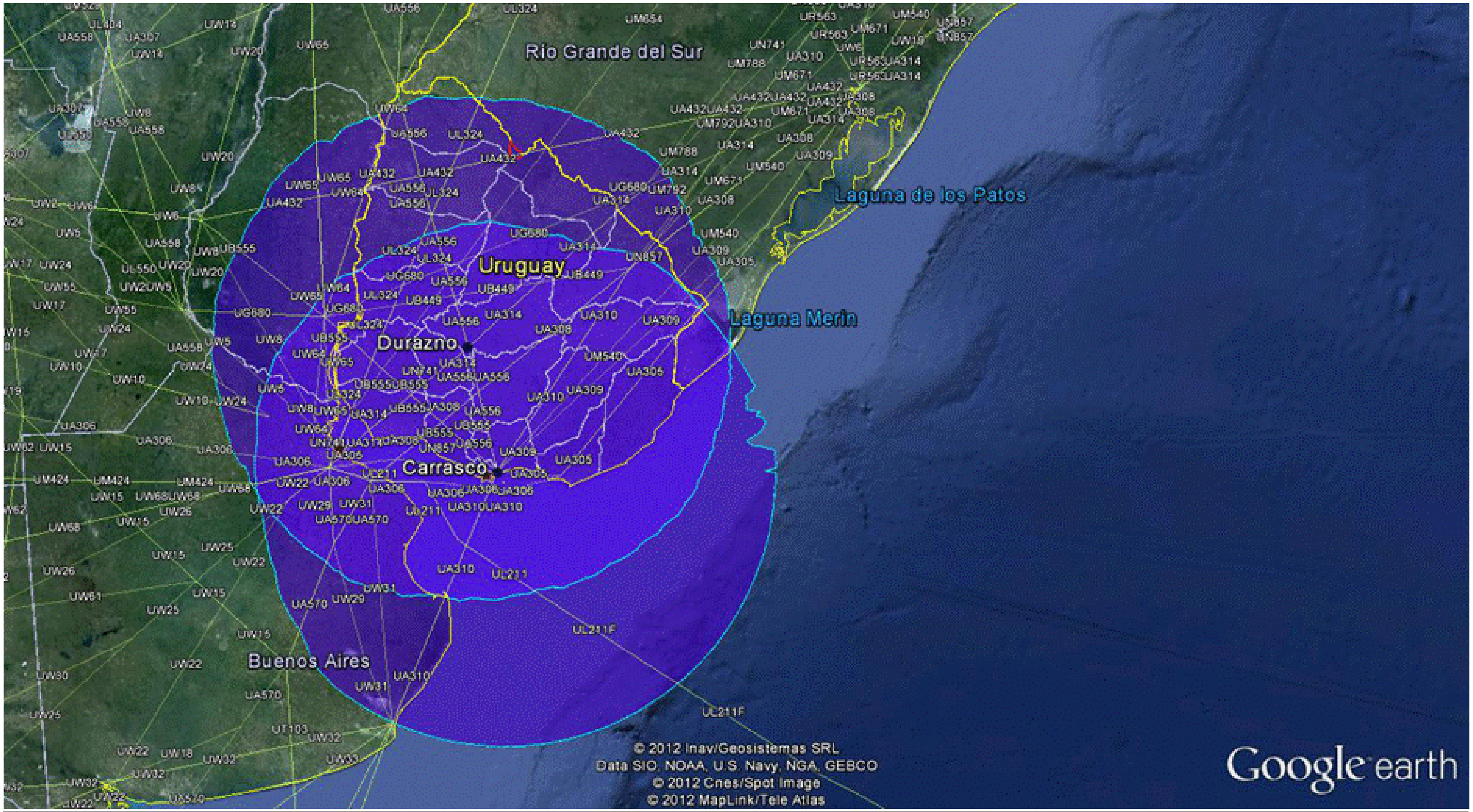

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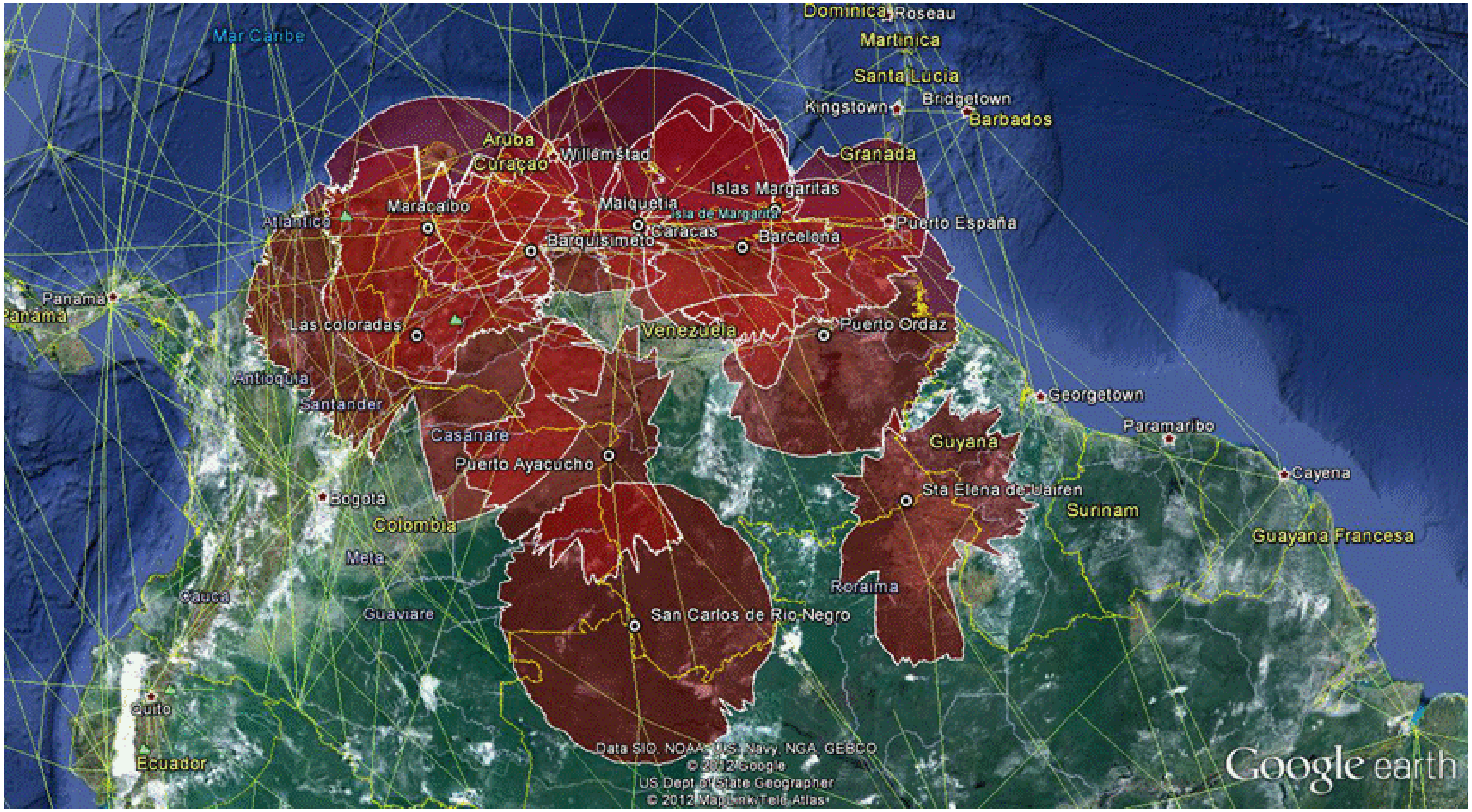
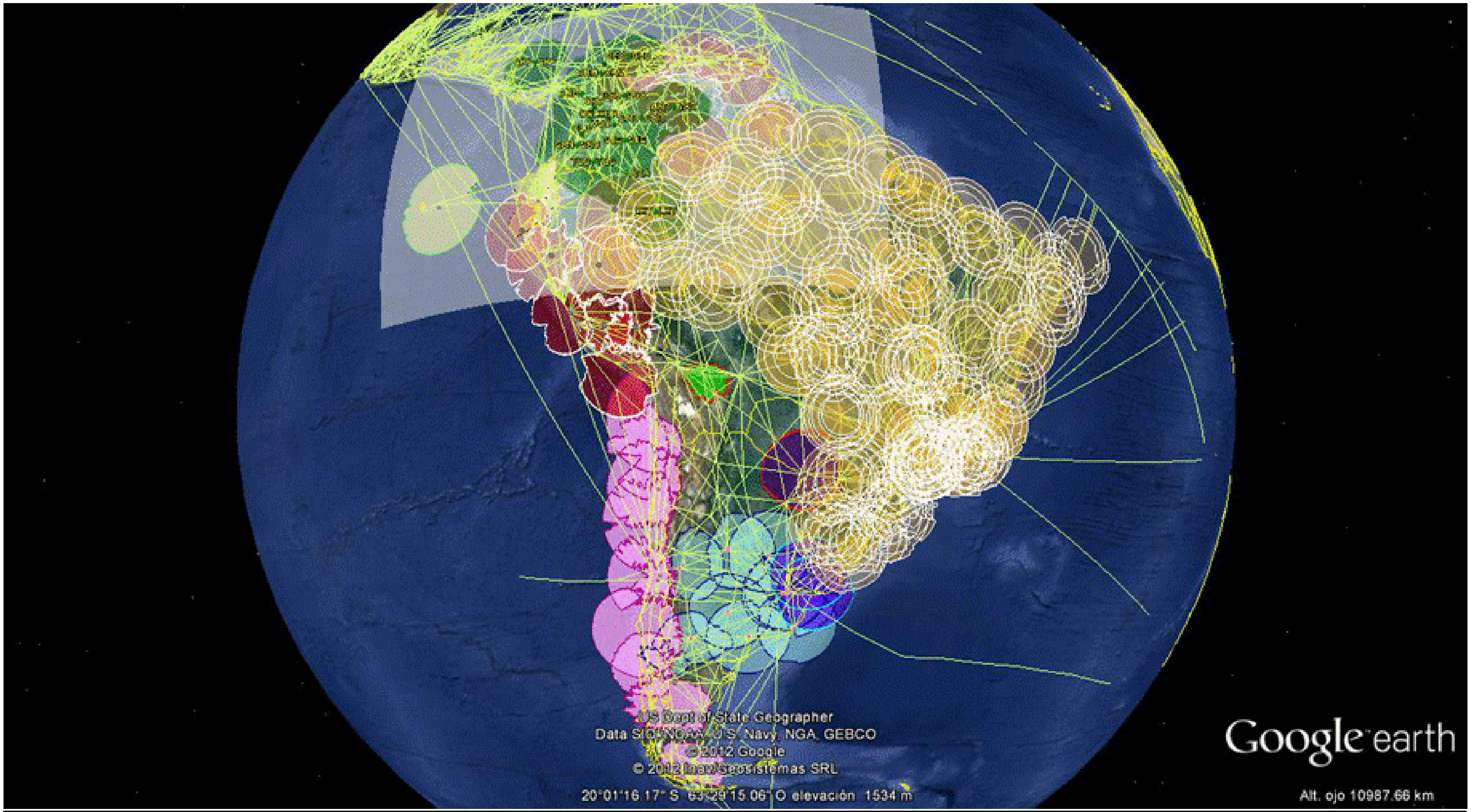


TOTAL SAM REGION



APPENDIX 8 – RECEIVER AUTONOMOUS INTEGRITY MONITORING SYSTEM - RAIM

Definitions and technical considerations

RAIM is a technology developed for assessing the integrity of the global positioning system (GPS) in a GPS receiver system. It is of special importance for critical GPS security applications, such as in aviation or maritime navigation.

In accordance with Doc 9849 AN/457 "GNSS Manual", the most common ABAS (AIRCRAFT-BASED AUGMENTATION SYSTEM) technique is the so-called RAIM (RECEIVER AUTONOMOUS INTEGRITY MONITORING).

For air navigation operations based on the global navigation satellite system (GNSS), Annex 10, Vol. I, Table 3.7.2.4.1 – Signal-in-space performance requirements for en-route, non-precision approach (NPA), approach with vertical guidance (APV), and terminal area operations supported by an aircraft-based augmentation system (ABAS), specifies that aircraft equipped with GPS receivers must have certified RAIM systems that meet the specified accuracy, integrity, and continuity parameter monitoring requirements.

Before starting its flight, every aircraft should check if RAIM is available throughout the route, and the corresponding ATS unit should also know what is the RAIM availability in its area of responsibility. RAIM operation is checked using a software application called RAIM availability prediction, which indicates the operating condition of the GPS constellation through messages called NANU (Notice Advisory to Navstar User).

States should be aware that RAIM algorithms require a minimum of five satellites on sight for fault detection (FD) and for detecting the presence of a position error that is unacceptably significant for a given flight mode. For fault detection and exclusion (FDE), a minimum of 6 satellites is used not only for detecting a defective satellite, but also for excluding it from the navigation solution so that the navigation function may proceed without interruption.

Likewise, operating limitations and conditions that will have an impact on RAIM availability values must be known. The RAIM system requires redundant satellite distance measurements to detect defective signals and alert the pilot, which means that the integrity navigation guide provided by RAIM cannot be available 100% of the time.

For receivers that cannot take advantage of selective availability (SA) interruption, the average RAIM availability is 99,99 % for en-route operations, and 99,7 % for non-precision approach operations with a constellation of 24 GPS satellites. FDE availability ranges from 99.8 % for en-route operations to 89.5 % for non-precision approach operations. For receivers that can take advantage of SA interruption (*e.g.*, SBAS receivers), RAIM availability increases to 100% for en-route operations and to 99.998 % for non-precision approach operations. FDE availability ranges from 99.92 % for en-route operations to 99.1% for non-precision approach operations.

RAIM and FDE availability will be slightly lower for medium latitude operations and slightly higher for equatorial and high latitude regions due to the nature of the orbits. The use of satellites from multiple GNSS constellations or SBAS satellites as additional sources of spacing can improve RAIM and FDE availability.

RAIM Prediction

GNSS differs from traditional navigation systems in that satellites and areas of degraded coverage are in constant change.

In this sense, if the satellite fails or is put out of service for maintenance, it is not immediately clear what areas of airspace will be affected, if any. The location and duration of these interruptions can be predicted with the help of computer analysis and reported to pilots during the pre-flight planning process. However, this prediction process is not fully representative of all RAIM implementations in the different receiver models. Prediction instruments are generally conservative and thus predict a lower availability than what is actually encountered in flight for protecting lower-level receiver models.

Since RAIM operates in an autonomous manner, that is, without the help of external signals, it requires redundant pseudorange measurements. In order to obtain a 3D position solution, at least four measurements are necessary. In order to detect a fault, at least 5 measurements are necessary, and to isolate and exclude a fault (FDE), at least 6 measurements are necessary. Nevertheless, more measurements are frequently needed based upon satellite geometry. Normally, there are between 7 and 12 satellites on sight.

Test statistics used are based on the residual pseudorange measurement (the difference between the expected measure and the observed measure) and the level of redundancy. Test statistics are compared with a threshold value, which is determined based on the required probability of false alarm (PFA) and the expected measurement noise. In aviation systems, the action platform is set to 1/15000.

The horizontal integrity limit (HIL) or horizontal protection limit (HPL) is a figure that represents the radius of a circle centred on the GPS position solution, and which is assured to contain the true position of the receiver within RAIM specifications (*i.e.*, it meets the Pfa and the Pmd). The HPL is calculated as a function of the RAIM threshold and satellite geometry at the time of the measurements. The HPL is compared to the horizontal alarm limit (HAL) to determine if RAIM is available.

Regional actions concerning RAIM implementation

The SAM Region has been considering the need to have a RAIM prediction system, mainly in the SAM implementation group (SAMIG). Within this context, the Lima Regional Office circulated a letter asking SAM States about their willingness to have a regional RAIM system; most States responded their agreement.

As to the development of a RAIM availability prediction system for the SAM Region, a technical and financial solution was presented at the seventh workshop/meeting of the SAM Implementation Group (SAM/IG/7).

The SAM RAIM availability prediction programme would be placed in dual servers and would be accessed by users through the web, at an address to be determined. The application would be available 24/7 with availability in the order of 99.5%.

Two modalities have been considered for the implementation of RAIM availability prediction: one in which the programme would be installed and managed at the manufacturer´s premises, and the other in which the programme as well as the required software would be installed at a location in the Region under the supervision of the manufacturer or the service provider. In both modalities, the user would access the information through an Internet website hosting the RAIM availability prediction programme.

The implementation of a regional RAIM prediction programme would allow all the States of the Region to have a single programme where all operators could consult en-route, terminal, and approach PBN procedures.

APPENDIX 9 - ASTERIX CATEGORY 21 ED 1.8

Table 1 - Data Items of Category 021

Data Item Reference Number	Description	Resolution
I021/008	Aircraft Operational Status	N.A.
I021/010	Data Source Identification	N.A.
I021/015	Service Identification	N.A.
I021/016	Service Management	N.A.
I021/020	Emitter Category	N.A.
I021/040	Target Report Descriptor	N.A.
I021/070	Mode 3/A Code	N.A.
I021/071	Time of Applicability for Position	1/128 s
I021/072	Time of Applicability for Velocity	1/128 s
I021/073	Time of Message Reception for Position	1/128 s
I021/074	Time of Message Reception for Position – High Precision	2^{-30} s
I021/075	Time of Message Reception for Velocity	1/128 s
I021/076	Time of Message Reception for Velocity – High Precision	2^{-30} s
I021/077	Time of Report Transmission	1/128 s
I021/080	Target Address	N.A.
I021/090	Quality Indicators	N.A.
I021/110	Trajectory Intent	N.A.
I021/130	Position in WGS-84 co-ordinates	$180/2^{23}$ °
I021/131	Position in WGS-84 co-ordinates, high resolution	$180/2^{30}$ °
I021/132	Message Amplitude	1 dBm
I021/140	Geometric Height	6.25 ft
I021/145	Flight Level	¼ FL
I021/146	Intermediate State Selected Altitude	25 ft
I021/148	Final State Selected Altitude	25 ft
I021/150	Air Speed	N.A.
I021/151	True Air Speed	N.A.
I021/152	Magnetic Heading	$360/2^{16}$ °
I021/155	Barometric Vertical Rate	6.25 ft / min
I021/157	Geometric Vertical Rate	6.25 ft / min
I021/160	Ground Vector	N.A.
I021/161	Track Number	N.A.
I021/165	Track Angle Rate	1/32 °/s
I021/170	Target Identification	N.A.
I021/200	Target Status	N.A.
I021/210	MOPS Version	N.A.
I021/220	Met Information	N.A.
I021/230	Roll Angle	0.01 deg
I021/250	Mode S MB Data	N.A.
I021/260	ACAS Resolution Advisory Report	N.A.
I021/271	Surface Capabilities and Characteristics	N.A.
I021/295	Data Ages	N.A.
I021/400	Receiver ID	N.A.

APPENDIX D

SAM Region	**PROJECT DESCRIPTION (PD)**	**PD N° C2**	
Programme	**Project Title**	**Starting Date**	**Ending Date**
ATM Automation and Situational Awareness *(Programme Coordinator: Onofrio Smarrelli*)	Improve ATM Situational Awareness in the SAM Region *Project Coordinator: Paulo Vila (Peru)* *Contributing experts: José Rubira, Marcos Vidal and Jorge Otiniano (Peru); Javier Vittor (Argentina), André Jansen (Brazil)*	October 2011	November 2013
Objective	Develop guidelines supporting the implementation of improvements in the situational awareness of ATS units in the South American Region		
Scope	Guidelines supporting the implementation of various applications, such as common traffic visualization, common meteorological conditions visualization and communications in general • Analysis of the current surveillance infrastructure and identification of necessary improvements to support en route and terminal airspaces, airspace classification, PBN and ATFM • Implementation of ADS-B, ADS-c and/or MLAT surveillance systems at selected airspaces • Minimum common electronic information and data bases required in support of decision-making process and alert systems towards an interoperable situational awareness among centralized ATFM units • Implement flight plan data process systems (new FPL format) and data communications tools among ACC´s • Implement advanced automation support tools to contribute towards the sharing of aeronautical information		
Metrics	Drafting of following documents: • Regional surveillance strategy for the implementation of systems in support of improvement of situational awareness – revised • Evaluation of the surveillance systems coverage in the SAM Region - completed • Guideline on technical/operational considerations for ADS-B implementation – completed • Guideline on technical/operational considerations for MLAT implementation - completed • Guideline on technical considerations in support of ATFM implementation – completed • Guideline for the presentation of MET products in graphic fomat - completed		
Strategy	• All tasks will be conducted by experts nominated by States and organizations of the SAM Region members of the Project *Improve ATM situational awareness in the SAM Region*, under management of the project coordinator. Communications among project members, as well as between the project coordinator and programme coordinator, shall be carried out through teleconferences and the Internet. • Once studies are completed, the results will be submitted to the ICAO programme coordinator as a final consolidated document for its analysis, review, approval and presentation at the GREPECAS PPRC		

Goals	• Regional surveillance strategy for the implementation of systems in support to situational awareness improvement for July 2012. • Evaluation of SAM surveillance systems coverage for October 2012. • Guideline on technical/operational considerations for ADS-B implementation for June 2012 • Guideline for technical/operational considerations for MLAT implementation for June 2013 • Guideline for technical considerations in support of ATFM implementation for October 2013
Justification	• Improve situational awareness has been identified as a great support for ATM, contributing in the increase of safety and in flight efficiency • During the seventh meeting of the SAM Implementation Group (SAM/IG/7), a review was made to the project *Improve ATM situational awareness in the SAM* Region, considering the nomination of a coordinator for the SAM Region • In addition, a close relationship with the other programmes and their respective projects is necessary, with the aim of collecting the operational requirements demanded by the mentioned applications and their respective tentative implementation dates • This project contributes to the implementation of SAM PFF CNS 04, ATM 05, ATM 06 and MET 03 of the *Air Navigation System Performance-Based Implementation Plan for the SAM Region (SAM PBIP)*
Related Projects	• Air Navigation Systems in Support of PBN • Automation • ATFM • Implementation of the ICAO New Flight Plan Format • ATN Ground-ground and Air-ground Applications

Project Deliverables	**Relationship with Performance Based Regional Plan aligned with ASBU**	**Responsible**	**Status of Implementation**[1]	**Delivery Date**	**Remarks**
Evaluation of surveillance infrastructure and identification of surveillance systems improvements					
Evaluation of current surveillance systems coverage in the SAM Region	ANRF B0-84 ASUR	Paulo Vila (Peru)		October 2012	Presented as Appendix to the Guideline on technical/operational considerations for ADS-B implementation.
Drafting of regional plan for ADS-B and MLAT implementation					
Guideline on technical/ operational considerations for ADS-B implementation	ANRF B0-75 SURF ANRF B0-84 ASUR	José Rubira (Peru) Marco Vidal (Peru)		October 2012	The Guide includes comments from Brazil, Chile and Guyana, presented through SAM/IG/11-WP/06. The Meeting approved the Guide. Peru will later include considerations to determine the values recommended for NIC, SIL and NAC for operational application.
Guideline on technical/ operational considerations for MLAT implementation	ANRF B0-75 SURF ANRF B0-84 ASUR	Andre Jansen (Brazil)		May 2014	
Guideline on technical considerations in support of ATFM implementation	ANRF B0-35 NOPS	Javier Vittor (Argentina)		October 2013	The guideline will base itself on the CAR/SAM ATFM Manual approved through GREPECAS Conclusion 16/35
Guideline for the presentation of MET products in graphical format	ANRF B0-105 AMET	Jorge Otiniano (Peru)		May 2013	The document was delivered to the Secretariat for its review by the corresponding meteorology specialists.
Resources necessary					

[1] ***Gray****: Activity has not started*
Green*: Activity has or will deliver planned milestone as scheduled*
Yellow*: Activity is behind schedule on milestone, but still within acceptable parameters to deliver milestone on time*
Red*: Activity has failed to deliver milestone on time, mitigation measures need to be identified and implemented*

Agenda Item 7: Implementation of the new flight plan format

7.1 Under this Agenda item, the Meeting analyzed the following papers:

a) WP/11 - *Follow-up to the implementation of the new flight plan format* (Secretariat); and
b) NI/07 - *Follow-up to the implementation of the new flight plan format* (Secretariat).

7.2 The Meeting took note that of the total ACCs in the SAM Region, 30% made changes in their flight plan processing systems, 23% introduced converters, and the remaining took upon the manual solution for the implementation of the new format. 92% counts with the template to detect errors in the filling of flight plans from the AMHS/AFTN terminals.

7.3 The Meeting updated the information regarding the current situation in the implementation of the new flight plan format, shown in **Appendix A** to this Agenda Item.

7.4 The Meeting was informed that the implementation of the new flight plan format had been a success and that, even though some problems in the flight plan format presented themselves during the first days of the Amendment's validity period, which were then corrected.

7.5 The Meeting deemed convenient that the next step for States to take is the updating of their automated systems, with the aim that they can process and present the new information in the flight plan format, such as PBN capability on board an aircraft, the availability of new surveillance systems, as well as any other relevant information that the automated systems should present on the basis of operational requirements.

7.6 In this regard, the Meeting agreed that the *Preliminary reference system/subsystem specification for the air traffic control automation system*, document drafted to support SAM States in determining the minimum requirements that the automated systems at the ATS units should count with, would be updated by SAM/IG/12. The updating would include the new capabilities included in the new flight plan format to meet regional and domestic requirements. Brazil will present a draft updated document at SAM/IG/12 meeting.

7.7 With the aim of supporting States in the implementation of the new information contained in the new flight plan format and in the integration of the surveillance systems within the automated systems, the Meeting deemed it convenient that a three-day seminar/workshop be held in 2014, with the support of RLA/06/901 project.

APPENDIX A / APENDICE A

STATUS OF IMPLEMENTATION OF THE NEW FLIGHT PLAN FORMAT IN THE SAM REGION /
ESTADO DE IMPLANTACION EN LA REGION SAM DEL NUEVO FORMATO DE PLAN DE VUELO

STATE/ ESTADO	ACC	AFTN/AMHS	FDP
Argentina	Comodoro Rivadavia	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Manual
	Cordoba	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Automated / Automatizado
	Ezeiza	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Automated / Automatizado
	Mendoza	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Manual. Automation scheduled for end 2014 / Manual. Previsto automatización finales del 2014
	Resistencia	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Manual. Automation scheduled for end 2014 / Manual. Previsto automatización mediados del 2014
Bolivia	La Paz	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Manual. Automation scheduled for mid 2015 / Manual Previsto sistema de automatización para mediados del 2015
Brazil / Brasil	Amazonico	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Automated /Automatizado (use of converter) / (uso de convertidor)
	Atlántico	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Automated /Automatizado (use of converter) / (uso de convertidor)

STATE/ ESTADO	ACC	AFTN/AMHS	FDP
	Brasilia	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Automated /Automatizado (use of converter) / (uso de convertidor)
	Curitiba	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Automated /Automatizado (use of converter) / (uso de convertidor)
	Recife	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Automated /Automatizado (use of converter) / (uso de convertidor)
Chile	Antofogasta	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Manual
	Punta Arena	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Manual
	Puerto Montt	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Manual
	Santiago	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Manual. Automation scheduled for end 2013 Manual Previsto automatización finales del 2013
Colombia	Barranquilla	Not implemented(AMHS terminal) No implantado (terminal AMHS)	Manual. Automation scheduled for mid-2014 Manual Previsto automatización para mediados 2014
	Bogotá	Not implemented(AMHS terminal) No implantado (terminal AMHS)	Manual. Automation scheduled for mid-2013 Manual Previsto automatización para mediados 2013
Ecuador	Guayaquil	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Manual. Automation scheduled for mid 2013 / Manual Previsto automatización a mediados del 2013

STATE/ ESTADO	ACC	AFTN/AMHS	FDP
French Guiana (France) Guyana Francesa (Francia)	Rochambeau	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Automated / Automatizado
Guyana	Timehri	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Automated / Automatizado
Panama	Panama	Not implemented AMHS implemented in December 2013 / No implantado Sistema AMHS implantado en Diciembre 2013	Manual. Automation scheduled for October 2013 / Manual Previsto automatización octubre 2013.
Paraguay	Asunción	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Manual
Peru	Lima	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Automated (only in the new ACC expected to become operational at the end of October 2013) / Automatizado (solo en el nuevo ACC a entrar en operación a octubre 2013)
Surinam	Paramaribo	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Automated (out of service, working manually) / Automatizado (fuera de servicio, trabajando manualmente)
Uruguay	Montevideo	Not implemented / No implantado	Automated / Automatizado
Venezuela	Maiquetia	Implemented(AMHS terminal) / Implantado (terminal AMHS)	Automated/Automatizado (use of converter) / (uso de convertidor)

Agenda Item 8: Other business

8.1 Under this Agenda item, analyses were made to WP/12 - *Updating of the Air Navigation System Performance-Based Implementation Plan for the SAM Region* (Secretariat), WP/13 - *Alignment of Air Navigation Plans with the 4th. Edition of the global Air Navigation Plan* (Secretariat), WP/16 - *RLA/06/801 Project tasks* (Secretariat) and IPI/05 - The need for eTOD information from an industry perspective (Jeppesen).

Review of the Air Navigation System Performance-Based Implementation Plan for the SAM Region (SAM PBIP) in alignment with ASBU

8.2 The Meeting recalled that the *Air Navigation System Performance-Based Implementation Plan for the SAM Region (SAM PBIP)* was analyzed upon and approved by the Twelfth Meeting of Civil Aviation Authorities of the SAM Region (RAAC/12) held in Lima, Peru, from 3 to 6 October 2012.

8.3 In addition, the Twelfth Air Navigation Conference (AN-Conf/12) approved the new ICAO Aviation Systems Block Upgrade (ASBU) methodology, to form part of the new Global Air Navigation Plan, 4th Edition (GANP) (Doc 9750) and, through Recommendation 6/1 - *Regional performance framework – planning methodologies and tools*, approves that States and the Planning and Implementation Regional Groups (PIRG) finalize the alignment of regional air navigation plans with the GANP, focusing on implementing ASBU Block 0 modules.

8.4 In this respect, the Meeting analyzed the SAM PBIP aligned with the ASBU, developed by the ICAO SAM Regional office and revised during the *Workshop on ASBU Implementation: Alignment of Regional and National Air Navigation Performance Based Plans*, held in Lima, Peru, from 6 to 10 May 2013 by the States of the Region participating in the event. As a result, very few changes were made, which were included in the Plan shown in **Appendix A** to this Agenda Item.

Alignment of the air navigation plans with the fourth edition of the global air navigation plan

8.5 The Meeting took note of the action taken by Headquarters pursuant to Recommendation 6/1 for the development of the new Regional Air Navigation Plan in electronic format that would be ready to be circulated to the States in May 2014 for comments.

Programme of activities under RLA/06/901 Project

8.6 The meeting took note of the 2013 programme of activities of Project RLA/06/901 includes the task *"Development of a practical guide with detailed information on PBN operational applications and procedures"*, contemplated for Output 1.1, which has not been implemented due to lack of the required human resources.

8.7 Likewise the tasks contemplated for Output 1.10: "*Airspace modelling and fast-time simulation to assess the detailed study of the SAM ATS route network"* and *"Fourth workshop/seminar for assessing the risk to the implementation of version 2 of the SAM ATS route network Phase III"* cannot be implemented in 2013 due to the delay by some States in the delivery of the traffic data required for the cost-benefit analyses, and lack of completion by some States of the corresponding tasks defined in the ATSRO Action Plan for regional airspace optimization.

8.8 On the other hand, the task *"AIXM/e-TOD Seminar"* scheduled for Output 1.5 had to be suspended for reasons of human resource assignment and probably will not be implemented in 2013 and will have to be moved to the 2014 Programme.

8.9 Furthermore, the Secretariat has identified the need to assist States in the redesign of their terminal areas through adequate training. The reason is that the course on airspace design recently held in Miami showed that States would greatly benefit from the training of their experts and having a basic design to advance the implementation of a new performance-based design with continuous descent and climb operations.

8.10 In order to facilitate the implementation of such activities that could help States in meeting their regional commitments and creating a better trained new generation for human resources, the meeting considered it would be convenient analyse the possibility of requesting the support of the Regional Project RLA 06/901.

8.11 Note was also taken of the need of Ecuador, Argentina, Bolivia, Colombia, Paraguay, Peru, Venezuela and Uruguay for PANS OPS courses on procedure design. This is of vital importance in view of the insufficient number of experts in this area in these States, as shown during the debate on agenda item 3.

8.12 In view of the above, the Meeting agreed to ask the Regional Office to request the Project participants, through the "fast-track" mechanism, their approval to replace the tasks not executed by the Project, without increasing the budget approved by the RCC/6 meeting, with the following:

a) the PANS OPS course in Quito, Ecuador, under the conditions stated in item 3; and
b) the airspace design workshop in Lima, Peru.

The need for e-TOD information from an industry perspective

8.13 In this regard, Jeppesen delivered a presentation informing the Meeting about the quality and precision levels required for terrain and obstacle survey data mentioned in Annex 15 for areas 1, 2, 3 and 4.

8.14 In this sense, the Meeting considered that the presentation would be very useful for the activities carried out by the SAM AIM meetings concerning AIS-to-AIM transition. Accordingly, it asked Jeppesen about the possibility of making a more detailed presentation on e-TOD at the next SAMI/AIM/5 meeting to be held on 22-26 July 2013.

INTERNATIONAL CIVIL AVIATION ORGANIZATION

SOUTH AMERICAN REGIONAL OFFICE

AIR NAVIGATION SYSTEM PERFORMANCE-BASED IMPLEMENTATION PLAN FOR THE SAM REGION

Version 1.3

May 2013

TABLE OF CONTENTS

ATTACHMENTS TO THE DOCUMENT

FOREWORD

The Air Navigation System Performance-Based Air Navigation System Implementation Plan for the SAM Region is published by the ICAO South American Regional Office on behalf of States accredited and International Organizations involved. It considers implementations at short and mid-term, as indicated in the guidelines contained in the Global Air Navigation Plan and the plan initiatives required for evolution to a Global ATM System, as shown in the Global ATM Operational Concept.

The Regional Office, on behalf of States and Organizations involved, will publish the required revised versions of the plan to reflect current implementation activities.

Copies of the plan can be obtained by contacting:

ICAO SOUTH AMERICAN
OFFICE LIMA, PERU

E-mail	:	icaosam@icao.int
Website	:	www.lima.icao.int
Tel	:	+511 6118686
Fax	:	+511 6118689
Address	:	Apartado Postal 4127, Lima 100, Perú

The present edition (Version 1.1) includes all revisions and modifications until May 2011. Subsequent amendments and corrigenda will be indicated in the Record of Amendment and Corrigenda Table, according to the procedure established in page 5.

It should also be mentioned that a list of reference documents used in the preparation of this document is presented in **Attachment H**.

The issue of amendments and corrigenda is announced regularly through correspondence with States and International Organizations, and in the ICAO website, which holders of this publication should consult. The blank boxes facilitate the recording of amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS			
No.	Date applicable	Date entered	Entered by
1	May 2013		

CORRIGENDA			
No.	Date applicable	Date entered	Entered by

1. Chapter 1: Foreword

1.1 Objective

1.1.1 This *Air Navigation System Performance-Based Implementation Plan for the SAM Region* has been drafted taking into account the ICAO Global Air Navigation Plan (GANP) (Doc 9750), and is framed within the Aviation System Block Upgrades (ASBU) methodology, with the aim of achieving a more efficient and interoperable airspace to meet future capacity demand, without compromising air navigation safety.

1.1.2 This Plan seeks to establish an implementation strategy so that benefits can be obtained for the air navigation community, based on the ATM-related infrastructure and available and foreseen aircraft capabilities. The document contains the Regional vision for the air navigation system (AGA/AOP, AIM, ATM, CNS, MET, SAR, Human Resources and Safety), giving high priority to environmental protection, training and safety.

1.2 Scope

1.2.1 This migration plan covers the SAM Region up to its boundaries, and includes the short- and medium-term implementations of the systems in support of the air navigation services between 2012 and 2018, period including the development of ASBU Block 0 activities. The long-term initiatives required for the evolution to a global ATM system, as shown in the Global ATM Operational Concept, will be added to this Plan as they are developed and approved.

1.3 Background

1.3.1 The Global ATM Operational Concept was approved by the Eleventh Air Navigation Conference (Montreal, September-October 2003) and published as Doc. 9854-AN/458.

1.3.2 In order to align global planning to the ATM Operational Concept, the Eleventh Air Navigation Conference (AN-Conf/11), recommended States and Regional Planning and Implementation Groups (PIRG), through Recommendation 1/1, to consider the Concept as a common global framework to guide in the planning for the implementation of the systems in support of the air navigation services.

1.3.3 GREPECAS/15 approved Conclusion 15/1 for the development by the Group of a regional performance-based plan, in keeping with the Global Air Navigation Plan and the Global ATM Operational Concept.

1.3.4 The *Air Navigation System Performance-Based Implementation Plan for the SAM Region* was completed in May 2011, and approved by the Twelfth Meeting of Civil Aviation Authorities of the SAM Region (RAAC/12) (Lima, Peru, October 2011).

1.3.5 The 37 Session of the International Civil Aviation Organization (ICAO) General Assembly (2010) directed the Organization to double its efforts to meet the global needs for airspace interoperability while maintaining its focus on safety. The block upgrades initiative was formalized at the Twelfth Air Navigation Conference (AN-Conf/12) (Montreal, November 2012) andwill form part of the new GANP, 4th Edition (Doc 9750).

1.3.6 The block upgrades describe a way to apply the concepts defined in the GANP with the goal of implementing regional performance improvements. They include the development of technology roadmaps, to ensure that standards are mature and to facilitate synchronized implementation between air and ground systems and between regions. The ultimate goal is to achieve global interoperability. Safety demands this level of interoperability and harmonization but it must be achieved at a reasonable cost with commensurate benefits.

1.3.7 Through Recommendation 6/1 - *Regional performance framework – planning methodologies and tools*, AN-Conf/12 urged States and PIRGs to harmonize the regional and national navigation plans with the ASBU methodology in response to this.

1.3.8 The *Air Navigation System Performance-Based Implementation Plan for the SAM Region* has been aligned with the ASBU methodology.

1.4 **Stakeholder roles and responsibilities**

1.4.1 Stakeholders including service providers, regulators, airspace users and manufacturers are facing increased levels of interaction as new, modernized ATM operations are implemented. The highly integrated nature of capabilities covered by the block upgrades requires a significant level of coordination and cooperation among all stakeholders. Working together is essential for achieving global harmonization and interoperability.

1.4.2 States, operators and industry will benefit from the availability of Standards and Recommended Practices (SARPs) with realistic lead times. This will enable regional regulations to be identified, allowing for the development of adequate action plans and, if needed, investment in new facilities and/or infrastructure.

1.4.3 For the industry, this constitutes a basis for planning future development and delivering products on the market at the proper target time. For service providers or operators, block upgrades should serve as a planning tool for resource management, capital investment, training as well as potential reorganization.

2. Chapter 2: Air Traffic in the SAM Region

2.1 Traffic Forecast in the SAM Region

2.1.1 Aircraft movement forecasts are important for anticipating when and where may airspace or airport congestion occur, and thus, are essential for planning capacity increases. These forecasts play an important role in the implementation of CNS/ATM systems.

2.1.2 For purposes of this Plan, use has been made of the 2007-2027 forecasts prepared at the seventh meeting of the CAR/SAM Forecasting Group (Doc. 9917) that are relevant for the SAM Region within the framework of main traffic flows (see section 3.2 of this Plan). Accordingly, it is interesting to analyse the percentage of growth expected for that period, as shown in the tables contained in **Attachment A** to this document.

2.1.3 In summary, passenger traffic in the South American Region during the 2007-2027 period is expected to increase at an annual rate of 8.8%, reaching 73 million passengers in 2027. The aircraft movement forecast for the same period shows an annual increase of 7.9%, reaching 497.000 movements for 2027. See Attachment A – Tables 1A – 1B.

2.1.4 Always within the 2007-2027 period, it is expected that passengers between South American and Central America and the Caribbean will increase 8.9%, reaching 27 million passengers in 2027. Aircraft movement for that period may reach a figure of 8.2%, with 282.000 movements in 2027. See Attachment A – Tables 2A – 2B.

2.1.5 Between South America and North America for the period 2007 – 2027, an increase of 5.7% is expected per year, reaching a figure of about 173 million passengers for 2027. Aircraft movements may reach 5%, or 1.625.700 movements in 2027. See Attachment A – Tables 3A – 3B.

2.1.6 Finally, with respect to the South Atlantic, the Europe-South America corridor specifically, a growth of 5.4% a year is expected, reaching an approximate figure of 21.5 million passengers for 2027 and a growth in aircraft movements of 5.5%, reaching more than 90.000 movements in 2027. See Attachment A – Tables 4A – 4B.

3. Chapter 3: Planning considerations

3.1 Introduction

3.1.1 As traffic volume increases throughout the world, the demands on air navigation service providers in a given airspace increase, and air traffic management becomes more complex. Increased traffic density brings about an increase in the number of flights that cannot fly their optimum path.

3.1.2 It is foreseen that the implementation of the components of the ATM operational concept will provide sufficient capacity to meet the growing demand, generating additional benefits in terms of more efficient flights and higher levels of safety. Nevertheless, the potential of new technologies to significantly reduce the cost of services will require the establishment of clear operational requirements.

3.1.3 Taking into account the benefits of the ATM operational concept, it is necessary to make many timely decisions for its implementation. An unprecedented cooperation will be required at both global and regional level.

3.1.4 ICAO introduced the Aviation System Block Upgrades (ASBU) methodology as a systemic manner to achieve a harmonized implementation of the air navigation services.

3.2 Planning Methodology

3.2.1 After identifying ATM Systems with homogeneous areas and the main traffic flows, GREPECAS conducted a study of the current and foreseen fleet of aircraft and their capabilities, the forecast traffic figures and ATM System infrastructure, including human resource availability and requirements, amongst other elements. The methodology used for the analysis phase is shown in Figure 1, hereunder.

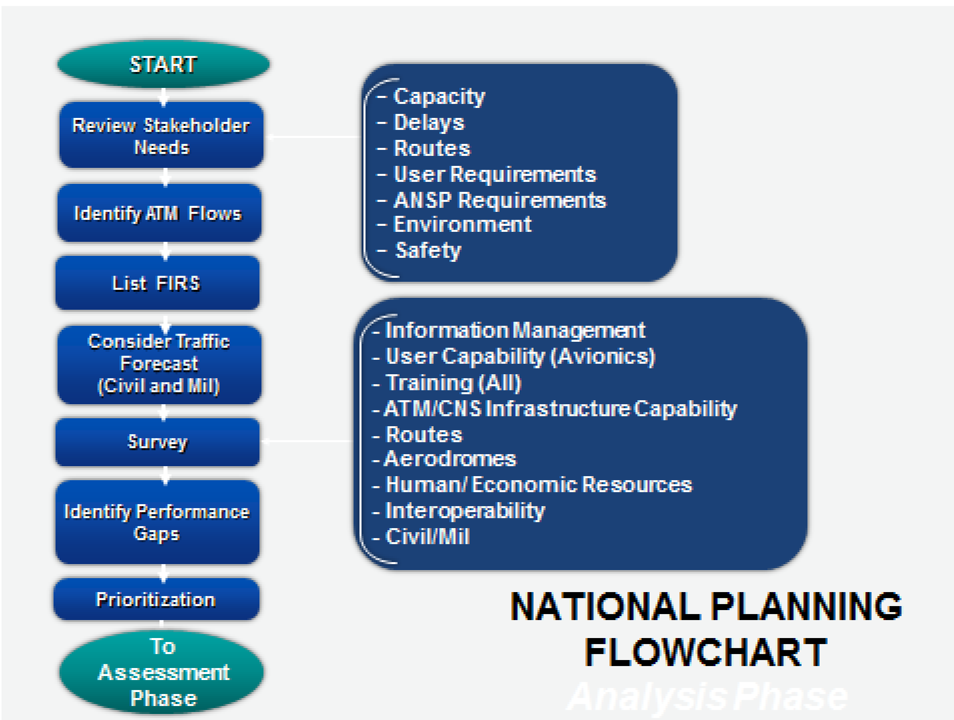


Figure 1 – Planning process (analysis)

3.2.2 An assessment made to the data obtained in the analysis phase enabled the identification of opportunities for the improvement of the operational performance. The ASBU modules and respective elements were analysed upon and selected with the aim of meeting the operational increases considered as necessary. The evaluation process used in indicated in Figure 2, hereunder:

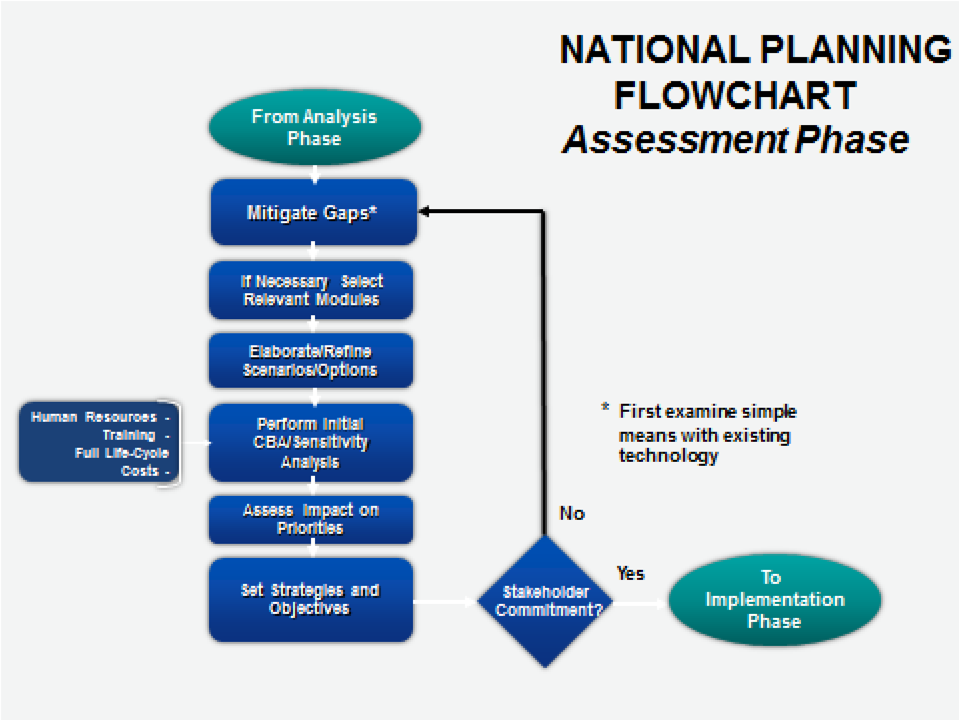


Figure 2 – Planning process (assessment)

3.2.3 The work for the SAM Region is organised based on project management techniques and clearly defined performance objectives to support the Global Plan strategic objectives aligned with the ICAO strategic plan.

3.2.4 All of the activities listed in the performance objectives will be designed based on strategies, concepts, action plan models and roadmaps that may be shared in order to align the inter-regional work with the main objective of maximising interoperability and transparency.

3.2.5 Planning of all the activities should ensure an efficient use of resources, avoiding duplicated or unnecessary activities or tasks, so as to make sure that such activities/tasks can be easily adjusted to the SAM Region. Planning must also encourage the optimisation of human resources, financial savings, and the use of electronic media, such as the Internet, videoconferences, teleconferences, e-mail, telephone and others.

3.2.6 The new processes and work methods must make sure that performance objectives can reflect based on timetables and regional progress reports to Regional Civil Aviation Authorities, GREPECAS, the ICAO Council and the ICAO Air Navigation Commission.

3.2.7 Based on this Implementation Plan, the States should develop their own national plan, containing the work programme, timetable, responsible parties and status of implementation, in order to monitor and report on the progress made in such activities. Additionally, it should also consider detailed information about the activities required for implementation, the means to provide feedback on the progress made through an annual reporting process, which will help administrations to prioritise the required actions and support, and identify annual assistance requirements of each ICAO Region.

3.2.8 The development of work programmes is based on the experience gained and lessons learned during the previous cycle of the CNS/ATM implementation process. Consequently, this Implementation Plan is aimed at maintaining a uniform regional harmonisation and improving implementation efficiency, taking advantage of infrastructure capacity and existing regional applications.

3.3 Planning tools: Implementation strategy within ASBU framework

3.3.1 An ASBU designates a set of improvements that can be implemented globally from a defined point in time to enhance the performance of the ATM system. There are four components of a block upgrade.

3.3.2 Module – is a deployable package (performance) or capability. A module will offer an understandable performance benefit, related to a change in operations, supported by procedures, technology, regulations/standards as necessary, and a business case. A module will be also characterized by the operating environment within which it may be applied. The date allocated to a module in a block is that of the initial operating capability (IOC).

3.3.3 Of some importance is the need for each of the modules to be both flexible and scalable to the point where their application could be managed through any set of regional plans and still realize the intended benefits. The preferential basis for the development of the modules relied on the applications being adjustable to fit many regional needs as an alternative to being made mandated as a one-size-fits-all application. Even so, it is clear that many of the modules developed in the block upgrades will not be necessary to manage the complexity of air traffic management in many parts of the world.

3.3.4 Thread – describes the evolution of a given capability through the successive block upgrades, from basic to more advanced capability and associated performance, while representing key aspects of the global ATM concept

3.3.5 Block – is made up of modules that when combined enable significant improvements and provide access to benefits.

3.3.6 The notion of blocks introduces a form of date segmentation in five year intervals. However, detailed considerations will call for more accurate implementation dates, often not at the exact assigned block date. The purpose is not to indicate when a module implementation must be completed unless dependencies among modules logically suggest such a completion date.

3.3.7 Performance improvement area (PIA) – sets of modules in each block are grouped to provide operational and performance objectives in relation to the environment to which they apply, thus forming an executive view of the intended evolution. The PIAs facilitate comparison of ongoing programmes.

3.3.8 The four PIAs are as follows:

a) airport operations;
b) globally interoperable systems and data – through globally interoperable system-wide information management;
c) optimum capacity and flexible flights – through global collaborative ATM; and
d) efficient flight paths – through trajectory-based operations.

3.3.9 Figure 3 illustrates the relationships between the modules, threads, blocks, and PIAs. Figure 4 explains the concept of the thread.

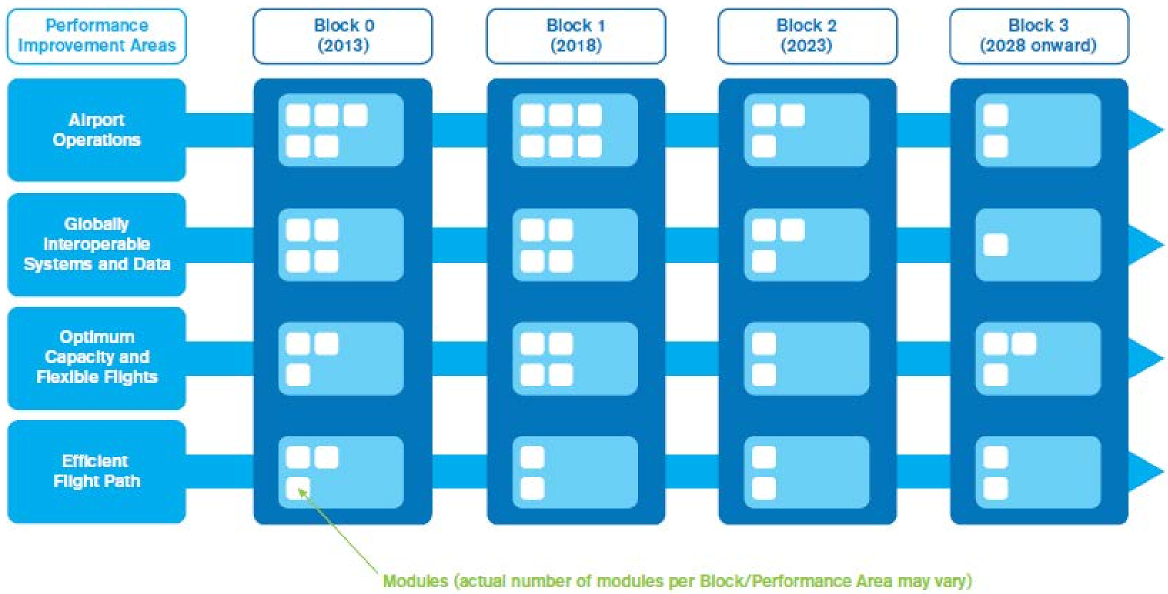


Figure 3. Summary of blocks mapped to performance improvement areas

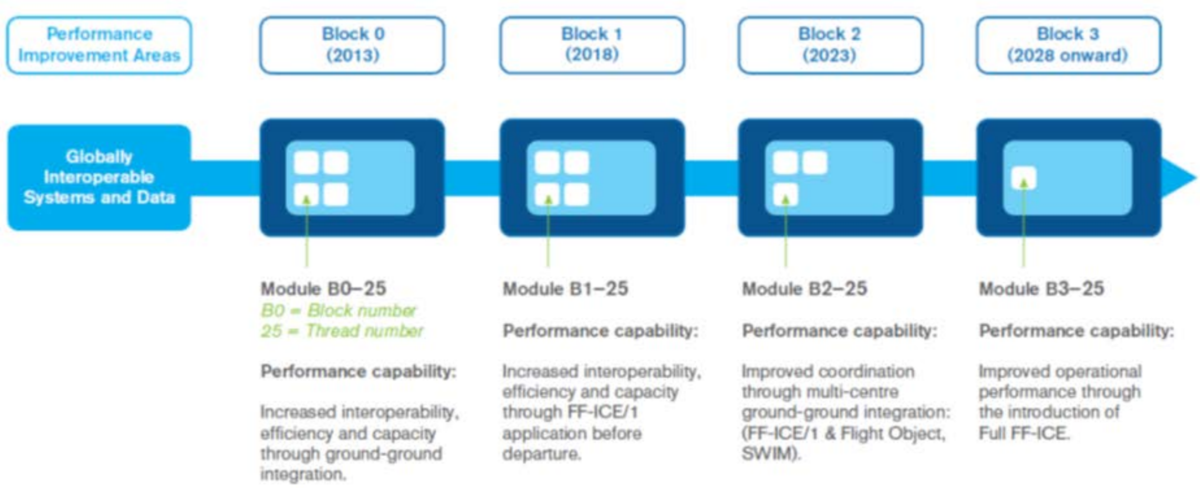


Figure 4. Module thread associated to a specific performance improvement area

3.3.10 In Figure 4, the modules under each block carry the same module number indicating that they are a part of the same thread.

3.3.11 Note that each block includes a target date reference for its availability. Each of the modules that form the Blocks must meet a readiness review that includes the availability of standards (to include performance standards, approvals, advisory/guidance documents, etc.), avionics, infrastructure, ground automation and other enabling capabilities. In order to provide a community perspective, each module should have been fielded in two regions and include operational approvals and procedures. This allows States wishing to adopt the Blocks to draw on the experiences gained by those already employing those capabilities.

3.3.12 Figure 5 illustrates the timing of each block relative to each other. Note that early lessons learned are included in preparation for the IOC date. For the Conference it is recognized that Blocks 0 and 1 represent the most mature of the modules. Blocks 2 and 3 provide the necessary vision to ensure that earlier implementations are on the path to the future.

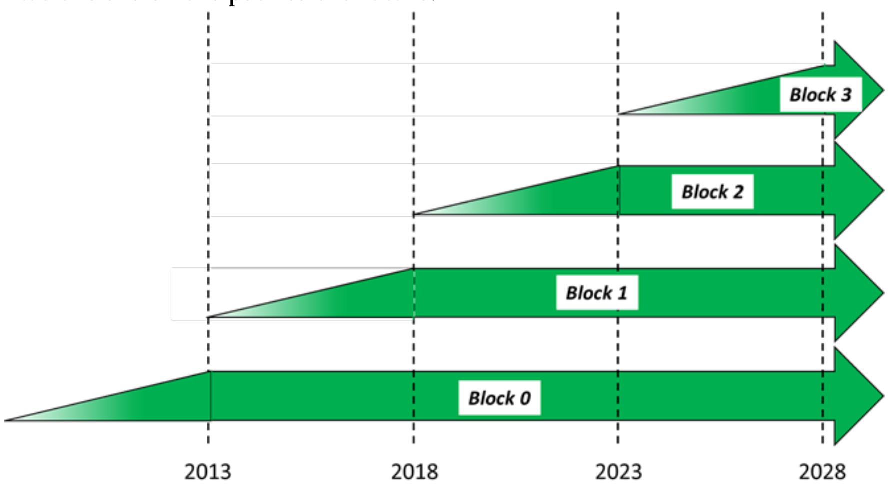


Figure 5. Timing relationships between blocks

3.3.13 An illustration of the improvements brought by Block 0 for the different phases of flight is presented in Figure 6. It highlights that the proposed improvements apply to all flight phases, as well as the network as a whole including information management and infrastructure.

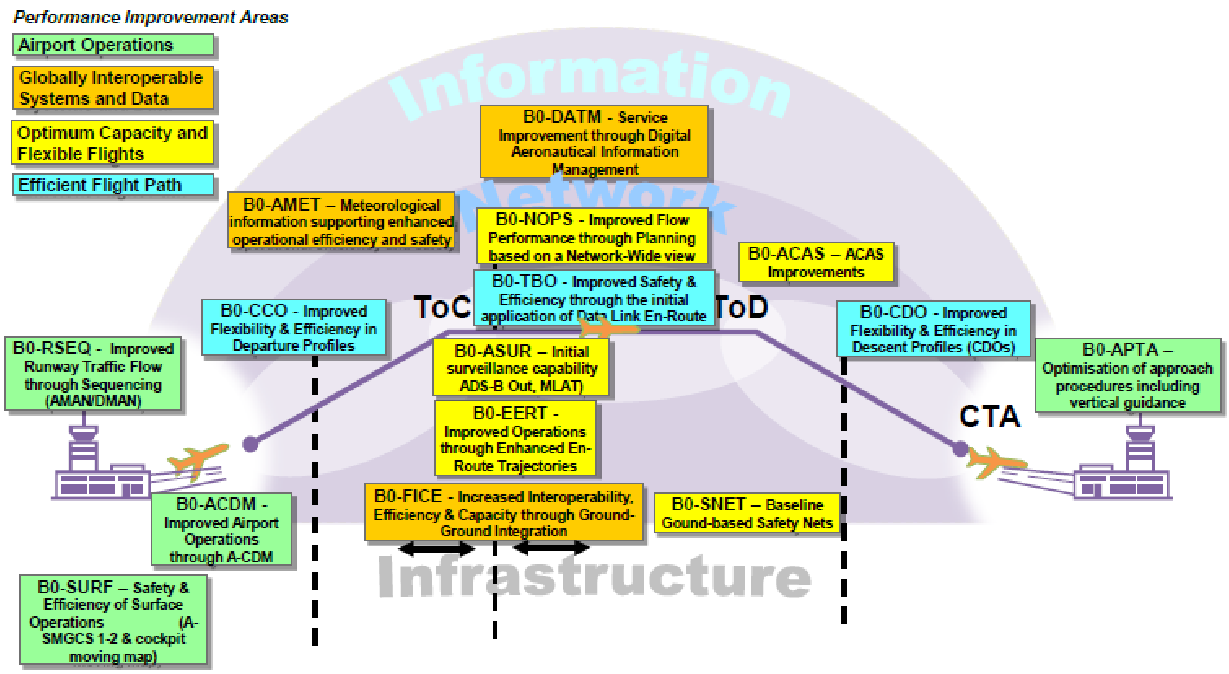


Figure 6. Block 0 in perspective

3.4 ASBU modules under consideration in the SAM Region

3.4.1 The Fourth Edition of the *Global Air Navigation Plan* introduces ICAO's ASBU methodology and supporting technology roadmaps based on a rolling fifteen-year planning horizon. Although the GANP has a global perspective, it is not intended that all ASBU modules are to be applied around the globe. Some of the ASBU modules contained in the GANP are specialized packages that should be applied where specific operational requirements or corresponding benefits exist.

3.4.2 Although some modules are suitable for entirely stand-alone deployment, an overall integrated deployment of a number of modules could generate additional benefits. The benefits from an integrated implementation of a number of modules may be greater than the benefits from a series of isolated implementations. Similarly, the benefits from the coordinated deployment of one module simultaneously across a wide area (e.g. a number of proximate airports or a number of contiguous airspaces/flight information regions) may exceed the benefits of the implementations conducted on an ad hoc or isolated basis.

3.4.3 An example of a need for global applicability would be performance-based navigation (PBN). Assembly Resolution A37-11 urges all States to implement approach procedures with vertical guidance in accordance with the PBN concept. Therefore, the ASBU modules on PBN approaches should be seen as required for implementation at all airports. In the same way, some modules are well suited for regional or sub-regional deployment and should take this into account when considering which modules to implement regionally and in what circumstances and agreed timeframes.

3.4.4 Based on the above paragraphs, it is important to clarify how each ASBU module fits into the framework of the SAM regional air navigation system. To assist in this regard, a module categorization and prioritization system has been developed below with the objective of ranking each module in terms of implementation priority. On the basis of operational requirements and taking into consideration benefits associated, SAM Region has chosen 15 out of 18 Block 0 Module for implementation as they respond to air navigation capacity and efficiency requirements for the Region for the period from 2012 to 2018.

3.4.5 The categories of 15 Block 0 Modules are as follows:

- **Essential (E)**: These are the ASBU modules that provide substantial contribution towards global interoperability, safety or regularity. The (3) modules for SAM Region are FICE, DATM and ACAS
- **Desirable (D):** These are the ASBU modules that, because of their strong business and/or safety case, are recommended for implementation almost everywhere. The (9) modules for SAM Region are APTA, ACDM, NOPS, ASUR, SNET, AMET, TBO, CDO, and CCO
- **Specific (S):** These are the ASBU modules that are recommended for implementation to address a particular operational environment or mitigate identified risks. The modules for SAM Region are NIL
- **Optional (O):** These are the ASBU modules that address particular operational requirements and provide additional benefits that may not be common everywhere. The (3) modules for SAM Region are SURF, RSEQ and FRTO

3.4.6 The modules considered and associated to each of the Performance Improvement Areas (PIA) are the following:

Performance Improvement Areas (PIA)	Performance Improvement Area Name	Module	Module Name
PIA 1	Airport Operations	B0-15 RSEQ	Improve Traffic flow through Runway Sequencing (AMAN/DMAN)
		B0-65 APTA	Optimization of Approach Procedures including vertical guidance
		B0-75 SURF	Safety and Efficiency of Surface Operations (A-SMGCS Level 1-2)
		B0-80 ACDM	Improved Airport Operations through Airport-CDM
PIA 2	Globally Interoperable Systems and Data - Through Globally Interoperable System Wide Information Management	B0-25 FICE	Increased Interoperability, Efficiency and Capacity through Ground-Ground Integration
		B0-30 DATM	Service Improvement through Digital Aeronautical Information Management
		B0-105 AMET	Meteorological information supporting enhanced operational efficiency and safety
PIA 3	Optimum Capacity and Flexible Flights – Through Global Collaborative ATM	B0-10 FRTO	Improved Operations through Enhanced En-Route Trajectories
		B0-35 NOPS	Improved Flow Performance through Planning based on a Network-Wide view
		B0-84 ASUR	Initial capability for ground surveillance
		B0-101 ACAS	ACAS Improvements

Performance Improvement Areas (PIA)	Performance Improvement Area Name	Module	Module Name
		B0-102 SNET	Increased Effectiveness of Ground-Based Safety Nets
PIA 4	Efficient Flight Path – Through Trajectory-based Operations	B0-05 CDO	Improved Flexibility and Efficiency in Descent Profiles (CDO)
		B0-40 TBO	Improved Safety and Efficiency through the initial application of Data Link En-Route
		B0-20 CCO	Improved Flexibility and Efficiency Departure Profiles - Continuous Climb Operations (CCO)

3.5 **Transition from PFFs to ANRFs**

3.5.1 With the introduction of the ASBU methodology to the Global Air Navigation Plan, 4th edition, it is expected that the Performance Framework Form (PFF) will be restructured and aligned with the ASBU modules, and renamed as Air Navigation Report Form (ANRF).

3.5.2 Nevertheless, these two forms will continue to be included in this Plan, as well as their inter-relationship, in order to serve as reference during the transition phase to ANRF, until the next edition of the SAM Region Plan, when only ANRFs will exist.

4. Chapter 4: Air Traffic Management (ATM)

4.1 Introduction

4.1.1 According to the Global ATM Operational Concept, the general objective of ATM is to achieve a global, inter-operational air traffic management system for all users during all flight phases, that meets the agreed levels of safety, provides optimum operations, is environmental sustainable, and meets national security requirements.

4.1.2 The future system must evolve from the current system so as to, inasmuch as possible, meets the needs of the users, according to clearly established operational requirements. The reality is that migration and integration are the most difficult institutional issues facing ATM system designers.

4.1.3 Airspace boundaries and divisions should not restrict the development of the airspace structure. Planning should be coordinated between adjacent areas in order to achieve a seamless airspace, in which the user does not perceive any division. The airspace should be free of operational discontinuities and inconsistencies, and should be organised in such as way as to accommodate the requirements of the different types of users. The migration between areas should be seamless to users at all times.

4.1.4 Human intervention within the human factors and training aspects is taken under consideration in all aviation improvement modules.

4.1.1 La consideración de la actuación humana en el marco de los factores humanos y el entrenamiento está considerada en todos los módulos de mejoras de la aviación en forma transversal.

4.1.5 Some of the benefits that are expected from the implementation of these components are improved safety, reduced operating fuel costs for users, reduced delays and gas emissions, and increased system capacity.

4.1.6 The evolution of air traffic management in the SAM Region has been carefully planned to avoid the degradation of the performance of the existing system. The safety level attained to date must be preserved during the transition, as a minimum, gradually improving air navigation efficiency. Consideration has also been given to avoiding an unnecessary overloading of aircraft with multiple CNS equipment, both existing and new, during the extended transition period.

4.2 General principles

4.2.1 Unrestricted access to air navigation services listed in this document must be guaranteed to all SAM States.

4.2.2 The need for SAM States to fully comply with national plans, as well as with the standards governing the use of the new systems, is acknowledged.

4.2.3 SAM States must accept the global nature of the ATM Operational Concept and the objective of providing integration mechanisms for its timely implementation.

4.2.4 CNS infrastructure must be carefully planned based on the requirements identified for the appropriate level of air traffic management in the SAM Region.

4.2.5 The new CNS elements shall be gradually introduced, taking into account the benefits to be derived by the ATM community.

4.3 Analysis of the current situation (2012)

Gaps of the current ATM system in the SAM Region

4.3.1 The ATM system currently available in the SAM Region presents some gaps, including the following:

a) Insufficient implementation of Performance-Based Navigation (PBN) and, in general, absence of airspace management (ASM);
b) The lack of a systematic use of cost-benefit analyses for the implementation of new airspace structures causes difficulties in the definition of air navigation infrastructure implementation priorities, and prevents measuring the benefits obtained by the ATM community;
c) The lack of implementation of the policy and procedures for the flexible use of airspace hinders airspace design and management, preventing the implementation of an optimum airspace structure and the use of optimum flight paths;
d) The lack of air traffic flow management (ATFM) in most airspaces of the SAM Region causes congestion in some airspaces and airports, and prevents optimum use of ATC and airport capacity, thus affecting users;
e) The lack of coordination in the provision of the existing CNS/ATM services sometimes generates a duplication of resources and services;
f) The inadequate quality of communication media and language difficulties create problems in the provision of air traffic services. Operations still rely on increasingly congested voice radio-communications for air-ground exchanges;
g) The lack of an ATS surveillance service in some portions of the airspace of the Region prevents a harmonised reduction of aircraft spacing, due to the application of different separation criteria in FIR boundaries (with and without ATS surveillance), thus restricting the use of optimum flight profiles;
h) The lack of harmonisation of automated ATM systems in the SAM Region, as well as the scarce sharing of ATS surveillance data, generates discontinuity in ATS services; and
i) Limited facilities for real-time exchange of information between ATM, aerodromes and aircraft operators, leading to a poor response to changes made in the operational requirements of users.

4.3.2 While in the later years, improvements have substantially occurred in some sectors, the limitations of the current ATM system result in inefficient aircraft operations. These limitations include:

a) The requirement to fly circling patterns in departure and arrival procedures;
b) Existence of airspaces of a permanent nature reserved for military purposes mainly;

c) Inadequate airspace planning prevents direct flights between the origin-destination airports and/or city pairs, and also operations at incorrect flight levels and/or speeds that make it difficult for aircraft to maintain optimum flight profiles;
d) Excessive ground and en-route delays related to the system;
e) Insufficient flexibility to properly address disturbances in airline operations caused by meteorological conditions, unexpected failures in CNS systems and airport services interruption;
f) Lack of harmonization in aeronautical publications, mainly instrumental procedures.

4.4 Strategy for the implementation of performance objectives

4.4.1 ATM evolution in the SAM Region has been planned taking into account the ASBU that could be applied in the short and medium term. ATM performance objectives, in addition to the requirements for the implementation of ATM improvements, determine the implementation dates of planned improvements, as well as the performance objectives.

4.4.2 The planning period considered is 2013 to 2018.

4.4.3 ATM evolution is based on:

a) En-route operations;
b) TMA operations; and
c) Air operations in general.

4.4.4 ATM Planning is based on following performance objectives, as shown in **Attachment C**, and as listed below:

a) En-route airspace optimisation (SAM ATM/01 PFF);
b) TMA airspace structure optimisation (SAM ATM/02 PFF);
c) Implementation of RNP approaches (SAM ATM/03 PFF);
d) Flexible use of the airspace (SAM ATM/04 PFF);
e) ATFM implementation (SAM ATM/05 PFF);
f) Improvement of ATM situational awareness (SAM ATM/06 PFF).

4.4.5 It should be noted that the different specialties (CNS, AIS; MET; AGA/AOP; SAR) developed in this Implementation Plan support ATM development and, in turn, constitute *per-se* an integrated, indivisible system. In particular, this Implementation Plan contains some cross-cutting issues that the States must especially address, namely:

a) Development of human resources and competence management (see Chapter 10); and
b) Safety management – SMS (see Chapter 11).

4.5 En-route operations

4.5.1 The evolution of ATM for en-route operations took into account the ASBU Block 0 modules applicable to the SAM Region and was planned in order to permit optimum airspace management and organisation.

PBN implementation for en-route operations

4.5.2 PBN implementation will foster the use of advanced aircraft navigation capabilities, which, combined with the air navigation system infrastructure, will permit airspace optimisation, including the ATS route network. Thus, it will promote an ATS routing environment that meets the needs of airspace users, reducing the workload of controllers and pilots and aircraft concentration in certain parts of the airspace that may generate congestion on the system.

4.5.3 The implementation of PBN for en-route operations will require the establishment of exclusionary airspaces, considering that these would provide the conditions for making the necessary changes to the airspace structure. So as not to exclude a significant number of users, the vertical limits of the airspace where PBN will be implemented shall be examined in depth, and so will the fleet operating in the Region.

Short term

4.5.4 Taking into account the low density of air traffic in oceanic airspaces, no changes are expected in the existing airspace structure. In those airspaces where RNP-10 is applied (EUR/SAM Corridor, the Lima-Santiago route and the South Atlantic Random Route System), no short-term changes are expected. Nevertheless, designation RNP-10 (RNAV10) must be completed in oceanic routes of the Pacific Ocean.

4.5.5 In the continental airspace, RNAV-5 has been implemented in the SAM Region.

Medium term

4.5.6 It is expected that RNP-4 will be implemented in the EUR/SAM Corridor, in the Santiago-Lima segment and in selected routes of the Pacific, using ADS/CPDLC, in order to permit the use of a 30-NM lateral and longitudinal separation. This implementation will depend on the evolution of the aircraft fleet operating in these airspaces. Also, the need for the use of the Aeronautical Mobile Satellite Service (AMSS) must be assessed, for situations in which immediate intervention of the air traffic controller is necessary, to ensure 30 NM horizontal separation.

4.5.7 During this phase, it is expected that RNP-2 will be implemented in selected continental airspaces, using mandatory GNSS, taking into account that the ground infrastructure will not support RNAV applications. It will be necessary to establish a back-up system for GNSS and to develop contingency procedures in case of GNSS failure. The implementation of RNP-2 will facilitate the implementation of PBN in airspaces with no ATS surveillance service. With the mandatory use of GNSS, more information about the GNSS signal will be required.

Situational awareness and en-route data relationship applications

4.5.8 The use of ADS-C and CPDLC in oceanic airspaces will foster the necessary conditions for using 30-NM horizontal separation minima in the EUR/SAM Corridor and in the Santiago-Lima route segment. The need for Aeronautical Mobile Satellite Service (AMSS) will be assessed to ensure such separation. Furthermore, in other oceanic airspaces with less traffic density, ADS-C and CPDLC will provide reliable surveillance and communication media, reducing the workload of controllers and pilots.

4.5.9 In the continental airspace, the use of enhanced surveillance techniques (ADS-B and/or multilateration) will help reduce horizontal separation minima, enhance safety, increase capacity, and improve the cost-effectiveness of flights. The use of CPDLC instead of voice communications could bring significant benefits in terms of safety and pilot and controller workload; however its use must be assessed taking into account that it might not be feasible due to the characteristics of ATC interventions.

4.5.10 These benefits may be achieved by providing surveillance in areas that lack primary or secondary radar when so warranted by cost-benefit analyses. In airspaces where radar is used, improved surveillance may help enhance the quality and reliability of surveillance information both on the ground and in the air. The States shall conduct a consistent cost-benefit analysis to determine if, when the time comes, PSR and/or SSR systems should be replaced by ADS-B systems or multilateration.

4.5.11 The gradual implementation of ATS inter-facility data communication (AIDC) will enhance airspace safety and reduce coordination errors between ATS units.

4.5.12 The implementation of ATS surveillance systems and data Relationship applications should take into account the corresponding automation aspects, mainly with respect to the need for harmonisation between the systems applied, with a view to ensuring system interoperability.

4.5.13 Furthermore, the implementation of ATS surveillance systems and data relationship applications should consider ATM automation tools (minimum safe altitude warning; conflict prediction; conflict alert; conflict resolution advisory; path conformance control; functional integration of ground and airborne systems, etc.).

4.5.14 Amongst others, the following applications that may assist with an improvement of the situational awareness, are identified:

a) TFMS - SYNCHROMAX or similar;
b) Surveillance tools to identify the boundaries of the airspace sector;
c) Use of A-SMGC at specific aerodromes, as required;
d) Availability of SIGMET in graphical format;
e) Dissemination of AIS; and
f) Implementation of D-VOLMET.

4.6 **TMA operations**

4.6.1 The evolution of air traffic management in terminal areas shall be harmonised with the evolution of ATM for en-route operations, providing for a harmonious and integrated ATM system.

4.6.2 The evolution of ATM for TMA operations took into account the ASBU Block 0 modules applicable to the SAM Region, and was planned so as to permit an optimum airspace management and organisation.

4.6.3 The TMA structure optimisation is supplementary related to the optimisation of the routes, through the use of approach procedures, SIDs, STARs, based on PBN, the application of TMA design and management techniques, and the functional integration of ground and airborne systems.

4.6.4 As regards situational awareness and implementation of data link applications, the close relationship between the implementation of enhanced surveillance techniques (ADS-B and/or MLAT) and the use of data link applications is taken into account.

4.6.5 There are many factors that should be taken into account when planning the requirements for a TMA air navigation service infrastructure. In addition to traffic volume, consideration should be given to other factors, such as: number and location of aerodromes, traffic characteristics, terrain, meteorological conditions, etc. Therefore, the States should analyse each particular TMA and determine, in coordination with the users, the requirements for the implementation of the corresponding air navigation services.

TMA structure optimisation

4.6.6 TMA airspace structure optimisation will be achieved through the following measures:

a) PBN implementation, which includes the implementation of SIDs and STARs with RNP and/or RNAV, and RNP approach procedures;
b) Implementation of continuous descent operations (CDO) and continuous climb operations (CCO);
c) The functional integration of ground and airborne systems; and
d) The use of improved design and management techniques.

Implementation of PBN for TMA operations

4.6.7 TMA operations have specific characteristics, taking into account the separation minima applicable between aircraft, and between aircraft and obstacles. This also involves the diversity of aircraft, including low-performance aircraft that carry out arrival and departure procedures on the same path as, or close to the paths of, high-performance aircraft.

4.6.8 In this sense, the States shall develop their own national TMA PBN implementation plans, based on the CAR/SAM PBN Roadmap and in the Action Plan Model developed by SAMIG meetings. They shall seek harmonisation of aircraft separation criteria and the applicable RNAV and/or RNP criteria, in order to avoid the need for multiple approvals for intra- and inter-regional operations.

4.6.9 The efficiency of TMA operations in a PBN environment depends on aerodrome design and management and runway operations, taking into account that any air traffic flow increase in TMA operations shall be absorbed by airport infrastructure.

Short term

4.6.10 It is expected that States will apply RNAV-1 in selected TMAs, in environments with ATS surveillance service and adequate ground-based navigation infrastructure, permitting DME/DME and DME/DME/INS operations. During this phase, operations with equipped and non-equipped aircraft will be permitted, and RNAV-1 operations shall start when an adequate percentage of approved operations is reached.

4.6.11 In environments with no ATS surveillance service and/or where there is no adequate navigation infrastructure on the ground, it is expected that the States will apply Basic RNP-1 in selected TMAs, applying mandatory GNSS, provided there is an adequate percentage of approved aircraft. Nevertheless, operations with approved and non-approved aircraft will be permitted in these TMAs once the corresponding operational benefits are verified. The implementation of overlay procedures and exclusive RNP procedures will depend on air traffic complexity and density.

4.6.12 It is expected that approach procedures with vertical guidance (APV) Baro-VNAV RNP APCH in all instrument flight runways, as per Resolution 37/11 of the 37th Assembly maintaining conventional approach procedures for non-equipped aircraft.

4.6.13 It is expected that RNP with Mandatory Clearance approach procedures (RNP AR APCH) will be applied at airports in which obvious operational benefits can be obtained, based on the existence of significant obstacles. It has also been identified that RNP AR APCH application in the Region may improve interference problems among airports, due to the proximity existing among them.

4.6.14 It is expected that States apply PBN for TMA operations, in order to flight implement procedures that provide more efficient trajectory during approach of an aircraft to the destination aerodrome. These procedures shall enable an un-interrupted flight trajectory from the beginning of the descent until the aircraft is stabilised for the landing. Recognizing environmental benefits and operations efficiency, with the aim to ensure safety, States should include continuous descent operations (CDO) implementation in their plans, according to the ICAO CDO Manual (Doc 9331).

4.6.15 As traffic demand increases, the challenges in terminal areas centre on volume, hazardous meteorological conditions (such as severe turbulence and low visibility), adjacent airports and special activity airspace in close proximity whose procedures utilize the same airspace, and policies that limit capacity, throughput, and efficiency.

4.6.16 Continuous Climb Operations (CCO) integrates with other airspace and procedures (PBN, continuous descent operations (CDO), and airspace management) to increase efficiency, safety, access and predictability; and minimize fuel use, emissions, and noise. States should include continuous climb operations (CCO) implementation in their plans, according to the ICAO CCO Manual (Doc 9993).

Medium term

4.6.17 During this phase, it is expected that the States will extend the implementation of RNAV or RNP-1 applications to selected TMAs, depending on ground infrastructure and aircraft navigation capacity. At more complex TMAs, RNAV or RNP-1 equipment will be mandatory (exclusionary airspace). At less complex TMAs, equipped and non-equipped aircraft will still be admitted.

4.6.18 During this phase, it is expected that the implementation of APV RNP APCH with Baro-VNAV and LNAV only in conformity with Resolution 37/11 of the 37th Assembly and RNP AR APCH procedures will be extended to selected airports. It is also expected that the GLS procedure will start to be used to improve the transition between the TMA and approach phases, basically using GNSS for the two phases.

4.6.19 In the mid-term, the application of other further advanced navigation specifications, such as:

a) Advanced RNP;
b) RNP 0.3 for helicopter operations;
c) Application of RF legs in Advanced RNP, Basic RNP1, RNP 0.3 and RNP APCH, according with specific operational requirements; and
d) RNP AR DEP.

Functional integration of ground and airborne systems

4.6.20 The optimisation of TMA efficiency will depend on a maximum use of automation. Likewise, aircraft will be increasingly equipped with time of arrival calculation. Thus, functional integration of ground and on-board systems will enable identification of times of arrival at specific fixes. These schedules should help in the landing sequencing process, allowing aircraft to remain close to their preferred 4D path, contributing to the application of one of the components of the ATM Operational Concept, which is Air Traffic Synchronisation.

Use of improved design and management techniques

4.6.21 Airspace planners should apply design techniques for TMA restructuring, with a view to:

a) Validating the proposed airspace structure;
b) Assessing the impact of PBN implementation, including RNAV, GLS procedures and/or RNP SID and STAR procedures, and FMS-based arrival procedures, using ATC simulations as needed;
c) Ensuring a favourable cost-benefit ratio; and
d) Optimising sectoring so as to make it seamless for users and balanced in terms of workload.

Situational awareness and data relationship applications for TMA

4.6.22 In addition to the considerations contained in the section on en-route operations, which also apply to TMA operations, the States should consider the following aspects for the implementation of ATS surveillance services and data Relationship applications in the TMA.

4.6.23 The implementation of surveillance systems (ADS-B and/or multilateration) at the TMAs will provide the conditions required for the integration of en-route and TMA operations.

4.6.24 The use of ATS surveillance systems (SSR, ADS-B and/or multilateration) will permit the use of RNAV-based navigation specifications, taking into account that surveillance will permit flight monitoring for the detection of any path deviation. Thus, it will be possible to include in TMA operations those users that would not be approved for RNP operations.

4.6.25 The implementation of improved surveillance systems will facilitate the operation of aircraft not approved for RNAV/RNP, taking into account that the controller will be able to vector them to the final approach.

4.6.26 The implementation of CPDLC in the TMA is not expected, taking into account the characteristics of ATC intervention in these airspaces. However, other data Relationship applications will reduce the workload of controllers and pilots, such as: D-ATIS and digital flight plan clearance (DCL).

4.6.27 It should be noted that TMA users might not be equipped with data Relationship systems, since there is a significant number of low performance aircraft that fly in this airspace and might not be capable of being properly equipped. In that case, procedures must be developed to allow non-equipped aircraft to fly, unless air traffic density warrants the use of exclusionary airspaces.

Air operations in general

4.6.28 This part of the Plan includes aspects contributing towards efficiency and capability applicable to general air operations.

Flexible Use of Airspace (FUA)

4.6.29 The optimum, balanced and equitable use of airspace by civil and military users, facilitated by strategic coordination and dynamic interaction, will permit the establishment of optimum flight paths, while reducing the operating cost of airspace users.

4.6.30 SAM States should establish policies for temporary or permanent use of restricted airspaces, in order to avoid the adoption of airspace restrictions inasmuch as possible, and also consider and integrate in its air navigation system unmanned aircraft systems (UAS), a new component of the aeronautical system.

4.6.31 The implementation of the flexible use of airspace should start with an assessment of hazardous, restricted and prohibited airspaces that affect or could affect traffic flow.

4.6.32 The establishment of letters of agreement between ATS and military units or other users for the dynamic and flexible use of airspace should avoid restrictions to the use of airspace, thus accommodating the needs of all airspace users.

4.6.33 In those cases in which airspace reserved is inevitable, the letters of agreement should stipulate that the activation of reserved airspace should not exceed the time required. To that end, it will be necessary to develop paths for dynamic re-routing of aircraft to avoid such airspaces.

4.6.34 The cited paths should be published in the AIP to let users know of the need to take into account such possible deviations in flight planning.

4.6.35 FUA implementation requires convincing the reserved airspaces users, mainly military authorities of the States involved, assuring them that their needs will be met whether or not airspace restrictions are applied. Consequently, seminars/meetings with such authorities will be required to demonstrate the importance of an optimised use of airspace.

Air Traffic Flow Management (ATFM)

4.6.36 SAM States must seek for an adequate balance between demand and capacity, ensuring that in normal operational conditions, the ATM system is able to attend the existing demand of air traffic. Also, it is important to highlight that ATFM measures must not be used to solve eventual intrinsic deficiencies of the ATM system.

4.6.37 The implementation of timely measures for demand/capacity balancing, in case of events that reduce system capacity, for example adverse weather conditions and/or temporary problems in airport infrastructure or ATC, will avoid an overload of the ATM system and will create the conditions for maximising airport and ATC capacity. This should increase significantly airspace capacity and operational efficiency.

4.6.38 Considering that air traffic congestion and saturation problems in the Region, States that have not implemented yet, must initiate the application of air traffic flow management measures that should be initiated with the calculation and maximisation of ATC and airport capacity, particularly runway capacity.

4.6.39 ATFM implementation in the SAM Region should take into account the objective and principles established in Appendix AL to Item 3 of the GREPECAS/13 meeting, noting that ATFM measures must foster a maximum use of existing capacity without compromising safety.

4.6.40 The ATFM Operational Concept establishes a simple strategy that should be developed in stages, maximising available capacity and allowing the parties involved to gain sufficient experience.

4.6.41 The experience gained in other Regions and by some SAM States permits the application of basic ATFM procedures at airports.

4.6.42 Thus, ATFM in the SAM Region will be implemented by stages, based on the established operational requirements, in keeping with the SAM ATFM Operational Concept.

4.6.43 So as to reconcile national plans with the SAM ATFM Regional Plan, civil aviation administrations must take required measures and carry out a close follow-up of the regional development of ATFM, and draft an ATFM implementation programme, where implementation needs are determined, the impact it will have in the national ATC system, in airspace, air traffic services and in airport services, and pertinent coordination is established, to make feasible a harmonious and timely integral regional implementation.

4.6.44 In order to maximise its efficiency in a long-term, the feasibility of implementing a centralised ATFM that should be responsible for delivering the service in as much airspace as possible, provided it is homogeneous, should be assessed.

4.7 **Alignment with ASBU**

4.7.1 Of the ASBU Block 0 modules taken under consideration of the SAM Region, the ATM area contributes to PIA 1 modules B0-15, B0-65, B0-75, , PIA 3 modules B0-10, B0-35, B0-84 and B0-102 and PIA 4 modules B0-05, B0-20 and B0-40.

4.7.2 Following are the ATM PFF indicated in paragraph 4.4.4 reflected on the following ASBU Block 0 modules indicated in paragraph 4.7.1:

a) PFF SAM ATM/01 - *Optimization of the en-route airspace structure*, with module B0-10;
b) PFFSAM ATM/02 - *TMA airspace structure optimization*, with modules B0-05 and B0-20;
c) PFF SAM ATM/03 - *Implementation of RNP approaches*, with module B0-65;
d) PFF SAM ATM/04 - *Flexible use of airspace*, with module B0-10;
e) PFF SAM ATM/05 - *ATFM implementation*, with modules B0-15, and B0-35; y
f) PFF SAM ATM/06 - *Improve ATM situational awareness*, with modules B0-75, B0-84 and B0-102.

5. Chapter 5: Communications, Navigation and Surveillance (CNS)

5.1 Introduction

5.1.1 When implementing CNS systems, SAM States must consider the ATM operational requirements contained in this Plan.

5.1.2 In view of the requirements derived from the implementation of the ATM Operational Concept, SAM States shall consider planning improvements to, and the strengthening of, aeronautical communication, navigation and surveillance services, taking into account ASBU Block 0 modules of the Global Air Navigation Plan.

Communications

5.1.3 Communication systems contemplated in this plan respond to short- and medium-term expectations of the operational requirements in the Region. Accordingly, this plan has taken into account the following communication systems:

a) Aeronautical message handling system (AMHS);
b) ATS inter-facility data communication (AIDC and OLDI);
c) Controller/pilot data Relationship communications (CPDLC);
d) Data link automatic terminal information service (D-ATIS);
e) Voice meteorological information for aircraft in flight (VOLMET) and data link (D-VOLMET);
f) Voice clearance delivery (CLRD) and data clearance (DCL); and
g) SAM Aeronautical Telecommunications network (ATN).

Navigation

5.1.4 The function of navigation systems is to support en-route, terminal, approach and landing operations and surface movements.

5.1.5 The navigation systems contemplated in this plan respond to short- and medium-term operational requirements of the Region. In this respect, this plan for navigation systems has taken into account the ground navigation infrastructure and the GNSS requirements concerning the operations foreseen in the CAR/SAM PBN Roadmap.

Surveillance

5.1.6 The function of surveillance systems is to provide aircraft position information to air traffic service units (ATS).

5.1.7 The surveillance systems contemplated in this plan respond to short- and medium-term operational requirements in the Region. Accordingly, this plan considers the following:

a) ADS-B;
b) ADS-C;
c) MLAT;
d) SSR; and
e) The integration of the aforementioned.

5.2 Analysis of the current situation (2012)

5.2.1 The current SAM communication, navigation and surveillance services situation in support of air navigation is described below, as per information provided in FASID CNS tables.

Communications - Aeronautical fixed service

5.2.2 AFTN service: The circuits foreseen have been fully implemented. However, and given their average life cycle, maintenance of the existing centres is a significant problem.

5.2.3 ATS speech service: The circuits foreseen have been fully implemented. Circuits are analogue and operate without any major problem.

5.2.4 AMHS service: This service has been implemented in almost all SAM States.

5.2.5 Memoranda of Understanding (MoU) have been drafted for the interconnection of AMHS systems between States.

Flight plan transfer

5.2.6 *OLDI*: It is available in several SAM States, although only one State uses it within the framework of its own administration.

5.2.7 *AIDC*: It is being implemented in many States.

Information delivery network

5.2.8 Currently, a satellite digital network (REDDIG) is available in the region to support the required aeronautical fixed services. In order to support the new services foreseen for the short and medium term, the new network to represent the regional ATN (REDDIG II), is in process of implementation.

Aeronautical mobile service

5.2.9 *VHF*: Services have been implemented as indicated in FASID Table CNS 2A, ensuring coverage in most of the selected areas, with problems at lower levels in selected airspaces. In the case of terminal areas and aerodromes, many facilities do not follow the recommendation of having different frequencies for APP and TWR services. The clearance delivery (CLRD) service has not been implemented at the level required.

5.2.10 *HF*: Although required in FASID Tables CNS 2 A and 2B, the HF service is not being operationally used in many States of the Region. It is mainly provided at some States that have oceanic areas in their FIRs.

5.2.11 ATIS: Implemented according to Table CNS 2A, but in an insufficient number. Use is made of conventional audio recorders and analogue VHF transmitters.

5.2.12 *CPDLC*:

a) Continental airspace: Not yet implemented; and
b) Oceanic airspace: Service implemented at some oceanic FIRs, for FANS equipped aircraft.

5.2.13 *CLRD*: Implemented in very few airports for terminal area/aerodrome.

5.2.14 D-ATIS: Implemented in very few airports.

5.2.15 VOLMET: Implemented in only one State of the Region.

Navigation

5.2.16 Radio aids: All conventional radio navigation aid systems (NDB, VOR, DME and ILS) have been implemented and fully installed pursuant to Table CNS 3 (radio navigation aids). Regarding NDBs, a deactivation process is underway, starting with those stations where the NDB is installed next to a VOR/DME.

5.2.17 ABAS is being implemented in selected airspaces of the Region for en-route, terminal area and NPA operations.

Surveillance

5.2.18 Radar systems: Conventional surveillance systems (PSR and SSR) have been implemented and installed almost entirely in the SAM Region according to Table CNS 4 A (surveillance system). The surveillance systems specified in this table cover most of the terminal areas of the States in the Region. However, not all the routes in the Region are covered.

5.2.19 Radar data exchange: It only exists in very few States of the Region.

5.2.20 ADS-B and MLAT: No services have been enabled to date.

5.2.21 ADS-C: Service provided by some oceanic FIRs, with FANS-equipped aircraft.

5.3 **Strategy for the implementation of performance objectives**

5.3.1 CNS implementation shall be based on a harmonised strategy for the SAM Region, with action plans and consistent timetables, taking into account operational requirements and the corresponding cost-benefit analyses, comparing the current structure with the improvements to be achieved when the new systems are implemented. Consideration should also be given to analysing the existence of two or more technologies to meet the same operational requirement.

5.3.2 Planning has been based on four global aspects, as shown in **Attachment C**, and as listed below:

a) aeronautical fixed service in the SAM Region (PFF SAM CNS/01);
b) aeronautical mobile service in the SAM Region (PFF SAM CNS/02);
c) navigation systems in the SAM Region (PFF SAM CNS/03); and
d) air surveillance service in the SAM Region (PFF SAM CNS/04).

5.3.3 A cross-cutting issue is the management of ANS personnel competencies of the air navigation system (PFF SAM HR/01). In this sense, States must pay special attention to meet ICAO requirements (see Chapter 10).

Communications

Aeronautical fixed service

5.3.4 AMHS: During this period, it is expected that AMHS systems will be implemented in those States that still have an AFTN system in place. Likewise, during that period, it is expected that each one of the AMHS systems installed will be interconnected to its respective AMHS systems, as specified in FASID Table CNS 1Bb.

5.3.5 Communication services for the ATFM: States must make the necessary efforts to implement communication services that effectively support ATFM.

5.3.6 AIDC: The States must make efforts to install automated systems in all their ACCs, with AIDC capability, and use them for the automatic transfer of flight plans between adjacent ACCs.

5.3.7 Improvement of the regional ATN network: In order to implement all the new services in a harmonised manner, the current Aeronautical Telecommunication Network (REDDIG) requires improvements regarding its technological platform, communication protocols, and an increase in capacity for the delivery of information. To this end, it is expected that, during the cited period, a new ATN network will be available to support all the existing services as well as those foreseen. During this period, a study on the optimum network configuration for the region will be conducted and, once approved, it will start being implemented.

Aeronautical mobile service

5.3.8 VHF: States must ensure coverage of continental VHF communications for lower flight levels when so required by the operations. Likewise, separate VHF channels must be implemented for TWR and APP services in the terminal area.

5.3.9 HF: The HF service must be maintained in keeping with the requirements listed in Table CNS 2B, “HF network designators for CAR/SAM aeronautical stations”.

5.3.10 CPDLC: States that have oceanic areas in their FIRs must make efforts for the provision of CPDLC services in the corresponding ACCs. Likewise, for the continental area, a technical/operational study should be carried out within the planning period, to permit its later implementation.

5.3.11 DATIS: The States must start providing DATIS services to replace similar conventional services or where they do not exist.

5.3.12 VOLMET/D-VOLMET: In attention to the MET requirement, States should start providing VOLMET services through speech communications systems and data links.

5.3.13 Protection of the radio frequency spectrum: The States must make the necessary efforts to ensure the protection and proper use of the radio frequency spectrum assigned to aviation for radiocommunication services.

Navigation

Navigation systems

5.3.14 NDB: States must continue with the NDB phase-out plan, as defined by GREPECAS/14 (April 2007). It is estimated that, during the period defined in the plan, most NDB will be deactivated.

5.3.15 VOR/DME: During the period defined in the plan, it is felt that, as part of the transition to the GNSS, VOR/DME systems must be maintained in selected TMAs, gradually starting the deactivation of en-route VOR systems.

5.3.16 DME/DME: Taking into account en route PBN and TMA implementation, as well as the use of DME/DME navigation as a back-up to the GNSS system, States should maintain the current DME systems coverage and, if necessary, States should carry out studies permitting the coverage extension of selected airspaces.

5.3.17 ILS: It is foreseen that, within the planning period, ILS systems will remain operative.

5.3.18 GLS: Approaches based on CATI GLS will begin at airports that have an operational demand that warrants them.

5.3.19 Flight trial support systems: The States must consider modernising their in-flight and ground trial elements so as to be prepared for a PBN environment.

5.3.20 Protection of the radio frequency spectrum: The States must make the necessary efforts to ensure protection and proper use of the radio frequency spectrum assigned to aviation for radionavigation services.

Surveillance

Improvements to the air surveillance service

5.3.21 ADS-B and MLAT: The main means of surveillance will continue to be collaborative surveillance in the form of SSR radars, extensively used in TMA and en-route services, and Mode S in high-density TMAs. The use of ADS-B (ES Mode S receivers) and MLAT will start providing en-route and terminal area surveillance as required; strengthening surveillance in areas covered by SSR Modes A/C and S. ADS-B (ES Mode S) will be gradually implemented on the ground to cover en-route and terminal areas.

5.3.22 A-SMGCS: It is foreseen that surface movement guidance and control systems A-SMGCS will be implemented at airports where previous studies have identified this requirement.

5.3.23 ADS-C: All States responsible of an oceanic FIR shall make operational use of ADS-C surveillance.

5.3.24 Protection of the radio frequency spectrum: The States must make the necessary efforts to ensure protection and proper use of the radio frequency spectrum assigned to aviation for air surveillance services.

5.4 Alignment with ASBU

5.4.1 Of the ASBU Block 0 modules taken under consideration of the SAM Region, the CNS area contributes to PIA 1 modules B0-65, B0-75 and B0-105, PIA 2 module B0-25, PIA 3 modules B0-35, B0-84 AND B0-102 and PIA 4 module B0-40.

5.4.2 Following are the CNS PFF indicated in paragraph 5.3.2 contributing with ASBU Block 0 modules indicated in paragraph 5.4.1:

a) PFF SAM CNS/01 – *Aeronautical fixed service*, with modules B0-25 and B0-35;
b) PFF SAM CNS/02 – *Aeronautical mobile service*, with module B0- 40;
c) PFF SAM CNS/03 – *Navigation*, with module B0-65; and
d) PFF SAM CNS/04 – *Surveillance*, with modules B0-15, B0-75, B0-84 and B0-102.

6. Chapter 6: Meteorology

6.1 Introduction

6.1.1 The next edition of the Global Air Navigation Plan (Doc 9750, GANP), will be presented to the ICAO Assembly in 2013 for approval. The draft GANP, and the aviation system block upgrade (ASBU) strategy it establishes, proposes that future air navigation technology and procedure improvements are organized and based on a consultative strategic approach that coordinates specific global performance capabilities and the flexible upgrade timelines associated with each component.

6.1.2 Meteorological information is an integral component of the tomorrow's system-wide information management (SWIM) environment, alongside aeronautical information, flight and flow information and other information sources. As meteorological information transitions from today's predominantly gridded, binary, alphanumeric and graphical formats to tomorrow's interoperable, non-proprietary code forms (such as XML/GML) within the SWIM environment using new exchange models like the weather exchange model (WXXM), tremendous potential exists to enhance the safety and the efficiency of the global air traffic management (ATM) system through enhanced availability and use of meteorological information. With this in mind, a planning threads promoting usage of integrated meteorological information to enhance operational decision making.

6.2 Meteorological information supporting enhanced operational efficiency and safety

6.2.1 In the near-term (Block 0), improved utilization by ATM of products from world area forecast centres, volcanic ash advisory centres and tropical cyclone advisory centres could support dynamic and flexible management of airspace, dynamically optimized flight trajectory planning, improved situational awareness and collaborative decision making. A focus on local arrangements is intended to enhance utilization of aerodrome warnings as well as wind shear warnings and alerts.

6.2.2 Meteorological challenges in routine operations often arise as a result of adverse and rapidly changing meteorological conditions. The proposed dynamic integration of ATM and meteorological (MET) information is expected to provide timely meteorological information to enable real-time identification, increased predictability and deployment of operationally effective ATM solutions to accommodate changing conditions, as well as facilitate tactical avoidance of hazardous meteorological conditions. Increasing use of airborne capabilities to detect and report meteorological parameters, and enhanced cockpit displays of meteorological information to enhance situational awareness, are additional elements of the strategy.

6.2.3 The Block 1 deployment includes initial ATM-MET integration, and actual and forecast meteorological information is compared with pre-characterized meteorological constraints on airspace or aerodrome threshold events using an ATM impact conversion process to identify near term capacity constraints. ATM decision makers are increasingly assisted by decision support tools using integrated meteorological information, consisting of automated systems and processes that create ranked mitigation strategies for consideration and execution.

6.2.4 At the Block 3 stage, far greater reliance is placed on airborne capabilities to provide meteorological awareness and drive tactical decision making including avoidance of hazardous meteorological conditions. Enhanced meteorological information is dynamically available to support the evolution of 4D trajectory operations. The 4D representations of meteorological information that have replaced traditional gridded, binary, alphanumeric and graphic formats provide wide benefits including increased access to meteorologically constrained airspace. ATM decision-making processes make extensive use of decision support tools that dynamically integrate meteorological information and propose mitigation strategies for consideration. Enhanced interpretation and mitigation of hazardous meteorological conditions results in extended pre-flight and flow planning capabilities.

6.2.5 The Technology requirements include the progressive establishment of an integrated 4D database capability of global meteorological information (observations and forecasts), as well as the deployment of automated systems to enable:

a) translation of raw meteorological data into predefined ATM constraints on airspace and aerodromes;

b) use of translated data to assess the impact on ATM operations, for traffic flows and individual flights; and

c) decision support tools, for both air navigation service providers (ANSPs) and users, which use ATM impact information to generate proposed mitigation strategies.

6.2.6 In the longer term, the availability of SWIM will enable further integration of meteorological information into both airborne and ground based tactical decision support tools.

6.2.7 The realization of globally interoperable, exchangeable meteorological information, including enhanced ground-to-air, air-to-ground and aircraft-to-aircraft meteorological reporting and exchange capabilities will be a significant undertaking.

6.2.8 The transition to integrated meteorological information will require agreement to, and development of, global standards for meteorological information exchange with an emphasis on the exchange of 4D (latitudinal, longitudinal, vertical and temporal) digitized meteorological information. Agreements are also necessary on what will constitute required meteorological information and graphical presentation in the digital information exchange era, to supersede the traditional gridded, binary, alphanumeric and graphic formats. Standardized meteorological information translation parameters and ATM impact conversion parameters will also require global agreement and development. Ensuring the accurate, reliable and wide availability of meteorological information remains a continuing challenge.

6.2.9 Meteorological information is recognized as a component of, ASBU modules concerning airport capacity, SWIM, flight and flow – information for a collaborative environment (FF-ICE), aeronautical information management (AIM), network operations, airborne separation, remotely-piloted aircraft (RPA), trajectory-based operations (TBO), continuous climb operations/continuous descent operations (CCO/CDO) and the global navigation satellite system (GNSS). Deployments from the meteorological information planning thread will need to take account of these wide interdependencies, therefore, States and users are urged to give due consideration to the potential added benefits which could result from the integration of a number of modules across a number of threads.

6.2.10 In this regard, the ASBU describe the way to apply the concepts defined in the Global Air Traffic Management Operational Concept (Doc 9854) in order to achieve local and regional performance improvements. The final target is to achieve global interoperability. Safety and efficiency require this level of interoperability and harmonization, which should be achieved at a reasonable cost and provide proportional benefits.

6.3 Analysis of the current situation

6.3.1 SAM States provide an aeronautical meteorological service that has been gradually improving in recent years. However, to ensure the availability accurate, reliable and comprehensive weather information, not all States have the necessary equipment, properly installed and / or maintained. In this respect it is essential that States have automated systems for data verification in accordance with the requirements set out in Annex 3 (thresholds). While quality management systems are in a good implementation process, the process of the quality of meteorological data should be the structure of Block 0.

6.3.2 Likewise, the lack of compliance with ICAO and WMO standards and recommendations referred to personnel involved in MET units is a deficiency that should be corrected by the States of the Region.

6.3.3 To obtain a mature QMS / MET in the region any effort by ICAO will be useless if there is not the commitment and performance of the senior management of the civil aviation administrations and providers of aeronautical meteorological services.

6.3.4 As a cross curricular subject to all these axes, there is the personnel competencies management (PFF SAM/HR 01) in accordance with the World Meteorological Organization (WMO) requirements.

6.4 Alignment with ASBU

6.4.1 Of the ASBU Block 0 modules taken under consideration of the SAM Region, the MET area contributes to PIA 1 modules B0-75 and B0-80, and PIA 3 module B0-105.

6.4.2 Following are the MET PFF indicated in paragraph 6.3.2 contributing with ASBU Block 0 modules indicated in paragraph 5.4.1:

a) SAM MET/01 PFF - *Implementation of the MET information quality management system*, with module B0-105;
b) SAM MET/02 PFF - *Improvements in MET facilities*, with modules B0-75 and B0-105;
c) SAM MET/03 PFF - *Improvements in the implementation of the international airways volcano watch (IAVW), in the surveillance of the accidental release of radioactive material, and in the issuance of SIGMET(s)*, with modules B0-80 and B0-105; and
d) SAM/MET 04 PFF - *Improvements in OPMET data exchange; and implementation and follow-up of the evolution of the WAFS*, with modules 0-80 and B0-105.

7. Chapter 7: Search and Rescue (SAR) Services

7.1 Introduction

7.1.1 The mission of SAR services is to find people in danger, help them and transport them to a safe place to receive proper care. The key for organising and having successful SAR services lies in top management, whose mission is to perform managerial tasks that will result in improved SAR operations, that is, the availability of an organised, trained and available SAR system capable of effectively helping people in danger.

7.1.2 The availability of SAR resources is often a critical initial capacity for responding and providing assistance to safe lives during the first stages of a disaster caused by natural causes or by the aviation activity *per se*. Accordingly, SAR services are sometimes part of an emergency management system.

7.1.3 SAR activities are an excellent means to encourage cooperation among States and organisations at the local, national and international level, since they involve missions that rarely create conflicting situations. Cooperation in this field may also lead to cooperation in other spheres. Such activities protect goods that may have a high value, which contributes to justify the existence of SAR services.

7.1.4 Close coordination between civil and military organisations is essential. National SAR coordination committees are a means for the establishment of such cooperation. The legislation should provide for the use of military and other public resources in support of search and rescue.

7.2 Analysis of the current situation (2012)

SAR requirements

7.2.1 The basic requirements for the establishment of an effective SAR system are:

a) The establishment of a regional framework concerning the need for availability of the SAR services that have jurisdiction over the different Search and Rescue Regions of the SAM Region;
b) Measures for using the available resources and procuring others as necessary;
c) The designation of the geographical areas of responsibility of the associated RCCs and RSCs;
d) Staffing, training and other personnel resources to manage and maintain the system in operation;
e) The appropriate and available means of communication; and
f) Agreements, plans, and related documents aimed at meeting the objectives and defining work relationships.

7.2.2 The periodic assessment of SAR requirements at regional level is very important for planning SAR resources and personnel in a coordinated manner, taking into account the respective SAR regions of the SAM States.

7.2.3 These updated and regionally harmonised requirements include, *inter alia*, the timely establishment of agreements between the different SAR services of SAM States for the provision of a regional search and rescue service, in keeping with the characteristics and needs of the aircraft fleet operating in the Region**.**

7.3 **Implementation strategy of performance objectives**

Risk management in practice

7.3.1 The use of risk management techniques gives some order to the uncertainty surrounding SAR organisations. It is an extremely useful tool for determining future work priorities and improving the capacity to meet the objective of the organisation, which is to find people in distress and take them to a safe location.

7.3.2 Risk analysis is a useful tool for those responsible for SAR organisations, since it can help in the assignment of resources that have priority for the organisation, and its results may be used to raise awareness amongst independent parties about the importance of search and rescue. SAR organisations should conduct a risk analysis and use the information thus obtained to increase their possibilities of saving lives. Planning has been based mainly on cooperation and Coordination of SAR services at a Regional level (SAM/SAR 01 PFF).

Quality management

7.3.3 Initiatives aimed at improving the quality of SAR services will substantially improve the results and reduce costs, mainly by eliminating the causes of unnecessary expenditures. These are important objectives for any administration, regardless of the volume of resources available.

7.3.4 The top management of a SAR system that assigns importance to quality tends to conduct more activities, make fewer mistakes, enjoy good reputation, and attract the resources necessary for the growth and better performance of the system.

7.3.5 In contrast, SAR organisations that do not pay attention to quality are subject to mistakes that may result in a reduced number of lives saved, the adoption of wrong or late operational decisions that create confusion, accidents and equipment failures, a deficient or inadequate use of resources, and unnecessary expenditure of economic resources.

7.3.6 Given the increasing air traffic activity and the use of large aircraft with a large passenger capacity, and its relationship with the responsibility of SAM States to protect human lives, it is important for SAR top management to develop a quality assurance programme for search and rescue (SAR) services, to be used as a quality management tool to ensure compliance with the objective of the national SAR plan of each SAM State.

7.3.7 This will also contribute to the provision of effective SAR services within the respective areas of SAR responsibility of each of these States, so as to foresee and particularly meet the many needs that would result from an accident with a large aircraft.

Competence of the search and rescue personnel

Training

7.3.8 Training is essential for operations and safety. The purpose of the SAR system is to save those who are in danger, and also to use training to reduce risks for the personnel and their means, which are very valuable. The training of personnel to conduct sound risk assessments will help ensure that the professionals who have received such training and the valuable means continue to be available for future operations.

Qualification

7.3.9 The purpose of the qualification is to validate the capacity of individuals to carry out certain tasks. They must demonstrate that they have a minimum level of knowledge and skills. This validation may be conducted in a specific position, through maintenance activities by a given team, or as a member of a group within a unit.

7.3.10 Qualification methods demonstrate the capacity of an individual to carry out concrete tasks. A qualification programme will cover the essential knowledge required to perform the functions in a given position and will test individuals in the use of the systems that they will have to manage or maintain.

Certification

7.3.11 The term certification is used in ICAO and other organisations within the context of authorising the personnel or the means to carry out certain functions. The term is also used to officially leave on record that an individual is duly trained and qualified to perform the tasks entrusted.

7.3.12 Thus, the objective of the certification is to authorise an individual to serve in a given capacity. Certificates should be issued to applicants that meet the conditions required for the service, as well as age, physical fitness, training, qualification, exam and maturity requirements. The certification must be issued in writing before the individual assumes his/her responsibilities in the surveillance service.

7.3.13 Training can only provide knowledge and skills at a basic level. Qualification and certification procedures help to demonstrate that sufficient experience, maturity and good judgment have been achieved. During the qualification process, the individual, upon showing his/her skill, should demonstrate that he/she is physically and mentally fit to be part of a group. Thus, the certification is the official acknowledgment by the organisation that it trusts the individual in the use of such skill.

7.3.14 The specific certification requirements vary according to the type of work location (ship, aircraft or RCC). The applicant to the title or certification may be assigned to a SAR specialist, who will observe how he/she carries out each of the tasks, and who will attest to his/her competence. A detailed knowledge of the geographical area of operation shall also be demonstrated. Certain tasks may require a periodic certification renewal.

7.3.15 Those responsible for managing the SAR service in general perform administrative functions; consequently, it is advisable that they participate in training courses on the following topics:

a) Planning;
b) Organisation;
c) Personnel;
d) Budget; and
e) Performance assessment

7.3.16 The use of means and personnel in search and rescue operations under severe weather or in rough terrain will require a special ability that is not generally learned through normal courses. Consequently, consideration should be given to the conduction of specialised courses for personnel training.

7.3.17 The SAM SAR/01 PFF reflects the short and medium term implementation strategy.

7.4 **Alignment with ASBU**

7.4.1 SAR planning aspects are not taken under consideration in ASBU.

8. Chapter 8: Aeronautical Information Services

8.1 Introduction

8.1.1 SAM States must consider the operational requirements of this Plan when implementing aeronautical information services.

8.1.2 In view of the requirements derived from the implementation of the ATM Operational Concept, SAM States shall consider planning for improvements to, and the strengthening of, Aeronautical Information Services, taking into account the initiatives of the Global Air Navigation Plan, as well as new provisions and requirements for short and medium-term implementation, and the related components of the aforementioned concept.

8.2 Analysis of the current situation (2012)

8.2.1 The AIS system currently available in the SAM Region presents deficiencies in some States, *inter alia:*

a) Lack of information with assurance of quality, integrity, and timely distribution of AIS products;
b) Activities are not data-oriented, and electronic information is not provided with quality assurance, in real time and with the capability of combining statistical and dynamic information in the same presentation;
c) Standard models are not used for the creation of integrated aeronautical, terrain and obstacle information data bases;
d) The English language is not used in AIS publications;
e) Topographic and land relief information is missing from instrument approach charts;
f) The geoid undulation is mission from aerodrome and heliport charts;
g) Quality control systems have not been implemented;
h) Automated systems have not been implemented;
i) The pre-flight information bulletin (PIB) is not provided;
j) Area minimum altitudes (AMA) are not included in route navigation charts;
k) English is not used in plain-language NOTAMs;
l) Post-flight information services are not facilitated;
m) Lack of training for AIS personnel;
n) Lack of aerodrome obstacle charts;
o) Lack of 1:500,000 aeronautical charts and 1:1,000,000 global chart;
p) Non-compliance with the AIRAC system; and
q) Lack of coordination between AIS/MET units for consistency between the NOTAM/ASHTAM and the volcanic ash SIGMET and for updating MET information in the AIP.

8.3 **Strategy for the implementation of performance objectives**

8.3.1 Planning has been based on two main axes, which are shown in Attachment C, and listed below:

a) Improving the quality, integrity and availability of aeronautical information (SAM AIM/01 PFF); and
b) Transition to the provision of electronic aeronautical information (SAM AIM/02 PFF).

Improving the quality, integrity and availability of aeronautical information

8.3.2 Full compliance with SARPs on quality assurance, integrity and timely availability of aeronautical information is a prerequisite for the transition to AIM.

8.3.3 In this sense, an action plan must be drafted and carried out to resolve current deficiencies as a prerequisite for the migration to AIM.

Aeronautical information regulation and control (AIRAC)

8.3.4 According to the AIS-AIM Transition Roadmap, the States must comply with the aeronautical information regulation and control (AIRAC) process. The quality of Aeronautical Information Services depends on the efficacy of the mechanisms for distribution, synchronisation and timing of said information.

Quality management system (QMS)

8.3.5 Quality management systems covering all the functions of aeronautical information services will be implemented and maintained.

8.3.6 The use of data sets on airborne equipment (FMS), automated systems for ATC, ground proximity warning systems (GPWS) and other systems related to an improved situational awareness make it absolutely necessary to implement processes to ensure the quality and integrity of the aforementioned data. These processes should be organised in a quality management system (QMS) applicable to all activities performed by the AIS.

8.3.7 The quality management system should be consistent with the ISO 9000 series and be certified by an accredited certification body. This certification is sufficient measure of compliance.

Monitoring of integrity in the data supply chain

8.3.8 Quality management systems should evolve until they are applied to all the data supply chain, starting at their origin.

8.3.9 In order to guarantee raw data integrity, service level agreements (SLA) must be established with the originators.

8.3.10 These SLAs will serve as a regulatory framework for the provision of data by the originators, and will contain details, *inter alia*, on: services to be provided, related indicators, acceptable and unacceptable levels of service, commitments and responsibilities of the parties, action to be taken in face of given events or circumstances, agreed data transmission formats, etc.

8.3.11 The SLAs are also a tool for measuring service performance, through the use of key performance indicators (KPIs).

Use of WGS-84

8.3.12 GNSS implementation requires the use of a common geodetic reference system. The SARPs determine that this common reference system must be WGS-84.

8.3.13 Consequently, the objective should be to express all coordinates in the WGS-84 reference system in an effective and verifiable manner. This requirement will also apply to future data products.

Transition to the provision of electronic aeronautical information

8.3.14 The transition to aeronautical information management (AIM) implies--as already stated--a data-oriented product. This transition to a digital format must be based on standard models and products that permit the exchange at a global level.

8.3.15 Based on this standardisation, the implementation of products and models will be done in a coordinated manner, at a global level, and in keeping with SARP updates resulting from new specifications.

Integrated aeronautical information database

8.3.16 For the design of the aeronautical information database, it is necessary to establish a conceptual model that defines the semantics of aeronautical information in terms of common data structures and takes into consideration the new requirements derived from the ATM Operational Concept.

8.3.17 The implementation of a conceptual model fosters interoperability and should serve as a reference in the design of the specified database.

8.3.18 Use will be made of an integrated aeronautical information database that integrates the digital aeronautical data of a State or Region and will serve to generate AIM products or services.

8.3.19 Use of database engines with spatial characteristics (geo-database) is highly advisable, since it enables data processing in geographical information systems (GIS).

8.3.20 Although it is not necessary for the design of these databases to be identical in all States or Regions, their modelling according to a common conceptual model would facilitate the subsequent exchange of data.

8.3.21 Database management may be carried out by a State or through regional initiatives.

Aeronautical information exchange model (AIXM)

8.3.22 An exchange model is essential for interoperability, since it establishes aeronautical data syntax for names and characteristics.

8.3.23 It will be established based on open standards (XML, GML), facilitating their incorporation into pre-existing or future systems.

8.3.24 It shall contemplate the exchange of dynamic information (NOTAM), enabling the extension of the traditional NOTAM format to give way to the digital NOTAM digital.

Terrain and obstacle database (e-TOD)

8.3.25 Ground proximity warning systems (GPWS), like the GIS-based procedure design and optimisation tools, require the electronic availability of high-quality terrain and obstacle data products.

8.3.26 To respond to this need, terrain and obstacle databases will be established according to common definitions that will be incorporated into the SARPs.

Electronic aeronautical information publication (e-AIP)

8.3.27 The eAIP must be considered as the evolution from the traditional paper-based AIP to the digital medium. The electronic version will have two formats: one will be suited for printing and the other will be accessible only through web browsers.

8.3.28 The eAIP must maintain a standard format, just like its predecessor, facilitating the exchange and preventing the proliferation of different presentations.

Electronic mapping and aerodrome mapping

8.3.29 Taking into account the technology available on board and in order to improve situational awareness, new digital mapping products suited to these devices will be established.

8.3.30 The use of the exchange model will allow these products to incorporate dynamic information in real time.

AIS-MET interoperability

8.3.31 Once an exchange model has been established and approved for AIM and a similar one for MET, it will be necessary to implement processes that promote AIS-MET interoperability and thus permit information integration.

8.4 Alignment with ASBU

8.4.1 Of the ASBU Block 0 modules taken under consideration of the SAM Region, the AIM area contributes to PIA 2 module B0-30 and module B0-105.

8.4.2 Following are the AIM PFF indicated in paragraph 8.3.1 that are reflected with the following ASBU Block 0 modules indicated in paragraph 8.4.1:

a) SAM AIM/01 PFF - *Improving the quality, integrity and availability of aeronautical information*, with module B0-30; and
b) SAM AIM/02 PFF - *Transition to the provision of electronic aeronautical information*, with modules B0-30 and B0-105.

9. Chapter 9: Aerodromes and Ground Aids / Aerodrome Operational Planning (AGA/AOP)

9.1 Introduction

9.1.1 SAM States must take into account the operational requirements of this Plan, including Ground Aids.

9.1.2 In view of the new requirements derived from the implementation of the ATM Operational Concept, SAM States shall consider the planning of improvements and strengthening of aerodrome services, pointing out that the ATM community includes as members the aerodromes, aerodromes exploiters and other parties contributing to the supply and operation of the physical infrastructure necessary for take-offs, landings and aircrafts flight stop services, taking into account the Global Air Navigation Plan initiatives as well as new provisions and requirements that require implementation in the short and medium term, and the related components of the cited concept (Attachment B).

9.2 Analysis of the current situation (2012)

9.2.1 Though aerodromes certification is a standard included in Annex 14 since 2003, only 5% of international airports were certified in the SAM region. Normally States do not update the information contained in the Air Navigation Plan, nor inform ICAO Regional Office about the correction of deficiencies registered in the GANDD database. Therefore, States in the Region commonly show difficulties to achieve their obligations regarding aerodromes surveillance, generating preoccupation regarding safety levels in such States, added to continuous increment of air transport demand, particularly when infrastructure is used up to capacity limits.

9.2.2 Recent introduction and implementation of new air navigation technologies contrasts with the lack of compliance of aerodrome standards, including difficulties in the adoption of new safety management tools now widely used in other human activities.

9.2.3 Most of the infrastructure of existing aerodromes were established when the design requirements were less stringent than today. Therefore, the certification of aerodromes built to less demanding requirements than current design requirements has become a barrier for the certification of aerodromes. However, safety assessment is a tool, through risk analysis and aeronautical studies, which allows aerodrome certification for those aerodromes that do not comply strictly with the standards and recommendations established by ICAO. For these cases, certification will become a reality, including always the operating conditions under which certification was granted. It is also important to determine the requirements for the safety assessment, mostly applicable when challenging natural conditions of the aerodrome leads to the development of a risk assessment/aeronautical studies. Thus, it is important to have appropriate regulatory mechanisms, solid in nature and well documented for resolving discrepancies or deficiencies that might exist in the accepted standard. However, it is important to understand that no waivers or exceptions are intended to overcome difficult compliance requirements.

9.2.4 In the AGA area, gaps that contribute to these scenery and that can affect efficiency of new air navigation technologies, such as absence or inadequacy of national regulation and orientation guidelines, lack of trained personnel to perform safety surveillance functions of exploited airports, difficulty for ensuring the supply, timely update and expedite dissemination of critical safety information, as well as information regarding terrain and emplacements that could constitute an obstruction or hazard to air navigation.

9.3 **Strategy for the implementation of performance objectives**

9.3.1 SAM States should make all possible efforts to warranty that aerodromes required physical characteristics and operational procedures followed by aerodrome exploiters correspond to ICAO standards and recommended methods (SARPS) and harmonise with Latin American regulations developed by the Regional Safety Oversight System (SRVSOP).

9.3.2 In the SAM Region, States must ensure that air navigation services support systems at aerodromes and their operators comply with national regulations, which shoul be harmonized with AGA LAR set, adopting the appropriate legal framework to formalize the responsibilities of the operator, whether the operation is public or private, and the Civil Aviation Authority.

9.3.3 The aerodrome should negotiate the increase of TMA operations in a safety environment, which requires identifying and optimising the critical elements at the inside and outside of the aerodrome that can influence this condition.

9.3.4 The optimization of TMA air space structure with the PBN implementation makes necessary measures that ensure an effective control with respect to emplacements in aerodromes proximity areas, taking into account the minima separation applicable between aircrafts and obstacles.

9.3.5 As first reference to these critical elements, the identification of aerodromes located near to operational saturation, followed by actions required to improve this capacity in terms of differentiation of these limits through the application of the best practices in the existing infrastructure, and, if necessary, in modified infrastructure, are interpreted as a necessary requirement.

9.3.6 Other external conditions to aerodrome operation that should be coordinated with responsible Regional Committees are the limitation of operations due to noise level, to the use of ground and to bird hazard, as well as the cancelation of operations due to adverse climatic conditions, that affect or limit the required optimization.

9.3.7 Planning has been based on main axes, which are shown in Attachment D, as listed below:

a) Quality assurance and availability of aeronautical data (PFF SAM AGA/01);
b) Aerodrome certification (PFF SAM AGA/02);
c) Safe aerodrome operations that to not meet ICAO SARPs (PFF SAM AGA/03);

d) Improvement of physical and operational characteristics of the aerodrome (PFF SAM AGA/04); and
e) Runway safety (PFF SAM AGA/05).

9.3.8 As a result of the assessment of aerodrome capacity factors directly affected by the increase in the flow of operations within the framework of safety management, strategies for achieving AGA/AOP objectives are identified, as summarised in five Performance Framework Formats (PFFs): Aerodrome information quality requirements, aerodrome certification, safe operations at aerodromes that do not meet ICAO SARPs (certificates with limitations), aerodrome capacity optimisation, and runway incursions and excursions.

Quality assurance and availability of aeronautical data

9.3.9 To achieve more efficient operations at aerodromes and reduce the risk of air accidents, it is necessary to ensure the quality and availability of aeronautical data by standardizing procedures and protocols of aeronautical data update, implementation and maintenance verification of the quality management systems covering all functions of aeronautical information services.

9.3.10 The tasks required to attain this performance objective includes the development of a regional action plan that identifies the need to update the information contained in Document 8733, CAR/SAM Navigation Plan, Vol. II FASID, Table AOP1. The updating of information will contribute to a reduction of air navigation deficiencies in the States, taking into account that many of them result from non-compliance with the information contained in Table AOP1 originally provided by the States. Likewise, it will be necessary to establish a juridical frame, as for example letters of agreement with AIM, not only to ensure the quality of aerodrome information, but also to update aerodrome obstacle data in the WGS-84 system through e-TOD.

9.3.11 Other task of special importance for the implementation of PBN is the adoption of systems by the States to ensure the control of emplacements near the aerodromes and the permanent monitoring to prevent irregular constructions and installations that affect negatively air navigation.

Aerodrome certification

9.3.12 Certification process of aerodromes is an indispensable requirement to improve safety in aerodromes and to establish in States an effective oversight by exploiters.

9.3.13 In cases where the State cannot overcome in the short term the difficulties for the certification of airports, it is necessary to establish multinational teams of experts of the region under the coordination of the SRVSOP that will carry out evaluations using the regulations and guides of the Regional System. The activities of the team, the obligations of the exploiter and the granting of the certificate would be issues to be convened.

9.3.14 It is important to guarantee the quality of the installations and services of the Aerodrome through a process of continuous training of the personnel involved in airport operations.

9.3.15 The adequate provision of AGA installations and services would depend of the management and competence of technical-operative personnel. Likewise, availability should be proportional to the amount of different services being supplies, based in a model that would ensure the quality of the airport system.

Safe Operations at Aerodromes non-compliant with ICAO SARPs

9.3.16 Conditions of certain part of the aerodromes infrastructure in the SAM region lead to believe that some aerodromes are susceptible of a certification with deviations regarding ICAO SARPS, however this do not exclude these aerodromes nor others of the Region to count with guidelines for the treatment of deficiencies and the implementation of operations in the aerodromes within a safety environment, which will stimulate risk management, auto audits from aerodromes and States (Document 9859) as well as ICAO audits.

9.3.17 The above requires of a regional plan to identify these aerodromes in the SAM Region, to develop guidelines by ICAO f or the implementation of aerodromes certification with deviation of ICAO SARPS, including in this guidelines the orientation towards cost efficient aeronautical studies development/SMS, to encourage States to the certification of their aerodromes. The implementation of certification of these aerodromes is also a safety objective in the SAM Region.

Improvement of physical and operational characteristics of the aerodrome

9.3.18 In term of Air Traffic Flow Management ATFM, conceptual changes of the aerodrome physical and operational characteristics should be introduced, taking into account ATFM in the strategy phase, airport exploiters should be conscious about airport capacity and its impact in the ATFM.

9.3.19 Some issues that should be considered in the structure are:

a) the design should contemplate the reduction of runway occupancy time;
b) safe manoeuvring under every meteorological conditions without capacity decrease;
c) precise guide of surface movements to and from a runway under every condition; and
d) position should be known (under an adequate level of precision) and the intention of all vehicles and aircrafts that carry out operations in the movement area, and these data should be available to the ATM community members.

9.3.20 The aerodrome exploiter should provide the necessary infrastructure, included, among others, visual aids, taxiways, runways and exits, as well as a precise guide of surface movements to improve safety and elevate to maximum the capacity of the aerodrome under every meteorological condition.

9.3.21 In order to establish a balance between demand and capacity, aerodrome exploiters should evaluate aerodrome capacities in order that air space users be able to determine when, where and how to perform operations, at the same time that conflict needs with respect to air space and aerodrome capacity are mitigated.

9.3.22 The capacity obtained through the aforementioned strategies relates to the installed infrastructure and its utilisation, understood as capacity with respect to the required demand. Accordingly, aerodrome capacity must be assessed based on saturation or near saturation under current and expected traffic conditions. Therefore, it is very important for the Region to identify airports that are close to this saturation condition in order to propose the development of manuals that contemplate, as a first objective, capacity improvements in runways, turning apron, taxiways and apron, based on the existing infrastructure and, as a second objective, the implementation of new infrastructure.

9.3.23 Accordingly, it is necessary to assess the aerodromes of the Region that are close to the point of saturation, develop a guide containing, as first measure, runway capacity optimisation procedures that use operational tools such as runway segregation, reference fields segmented runways, optimisation of surface movement and, as second measure, plan the new infrastructure that, in both cases, should be in harmony with the environment. It is necessary to include letters of operational agreement in this new operational condition, as well as the monitoring of the optimisation of runways and their supplementary systems.

Runway safety

9.3.24 The safety of aircraft operations with respect to conditions that cause runway excursions, may largely depend on pavement surface conditions, their behaviour under different weather conditions, and their use. Consequently, the identification and management of such conditions to keep them within acceptable levels favour this operational requirement. These characteristics are: friction on paved surfaces covered by snow or ice or water, surface drainage capacity, and rubber contamination.

9.3.25 The foregoing requires the development of a regional action plan for the identification of these runway surface safety requirements and the assurance of an acceptable SMS risk.

9.3.26 Likewise, aerodrome operators must report these operating conditions to users, authorities and providers, as a requirement for ensuring proper dissemination.

9.3.27 The States must monitor the progress of the programme, and this information shall be provided to ICAO in order to contribute to safety measurements.

9.4 Alignment with ASBU

9.4.1 From ASBU Block 0 modules taken under consideration of the SAM Region, the AGA area contributes to PIA 1 modules B0-15, B0-80 and B0-75 and PIA 2 module B0-30.

9.4.2 Following are the AGA PFF indicated in paragraph 9.3.2 contributing with ASBU Block 0 modules indicated in paragraph 9.4.1:

a) PIA 1 / B0-15 – Improve Traffic Flow Through Runway Sequencing (AMAN/DMAN) related to Improvement of physical and operational characteristics of the aerodrome-PFF SAM/AGA 04
b) PIA 1 / B0-75 –Safety and Efficiency of Surface Operations (A-SMGCS Level 1-2**)** related to Improvement of physical and operational characteristics of the aerodrome-PFF SAM/AGA 04
c) PIA 1 / B0-80 **-** A-CDM related to Aerodrome Certification **-**PFF SAM/AGA 02 and Safe Operations at Aerodromes non-compliant with ICAO SARPs - PFF SAM/AGA 03.
d) PIA 2 / B0-30 - Service Improvement through Digital Aeronautical Information Management related to Quality assurance and availability of aeronautical data. (PFF SAM/AGA01).

9.4.3 The PIA Module 1 / B0-80 A-CDM, aims to improve the operational efficiency of service providers at airports by reducing delays, increased prediction of events that may happen during the flight and optimizing the utilization of resources. The expected results, improved airport capacity, which can be reached if there are improvements in the exchange of information in real time between airport operators, aircraft operators, ground service providers and air traffic control. This concept involves the implementation of a set of operating procedures and automated processes. The Aerodrome area has identified this module as an opportunity to implement the AGA requirements in the SAM region.

9.4.4 Modules PIA 1 / B0-15, PIA 1 / PIA B0-75 and 2 / B0-30 have been identified by AGA as modules that allow collaboration with other areas of airspace, ATS, AIM and CNS.

10. Chapter 10: Development of Human Resources and Competence Management

10.1 Introduction

10.1.1 In view of the new requirements derived from the implementation of the ATM Operational Concept, SAM States shall consider planning the Development of Human Resources and Competence Management, taking into account the ASBU Block 0 modules.

10.1.2 The Air Navigation system allows for the collaborative integration of human resources, information, technology, facilities and services with the support of communications, navigation and surveillance. The provision of ATM services in the SAM Region will depend on the performance of individuals and the development of new competencies, making possible their interrelationship with the operational and technical environment. Each system is developed, maintained and operated by human beings that continue to be the most flexible and critical element to manage threats and errors in ATM operations. A seamless navigation scope will be required in the future. An international team prepared to perform its functions in that new operational scenario. To achieve this, the members of this team must receive a uniform and high quality level of training.

10.1.3 The role of the individual and his contribution to the Air Navigation System will mutate according to the changes presented in the Operational Concepts and the structure of the system. The proper provision of air navigation services will depend on the management of the competencies of technical and operational personnel, as well as on their availability in sufficient numbers to cover the different services. It will also demand a redefinition of the profile of the personnel required for the system.

10.1.4 In the past, the evolution of aeronautical technologies has been gradual and, to a large extent, Civil Aviation Training Centres (CATCs) and instructors have been able to face the challenges of change, even though they did not always have refined training methodologies and instruments available. However, the new ATM systems are based on many new concepts, and their implementation represents an even bigger challenge.

10.1.5 The introduction of these new concepts within the ATM system will make planning a critical element and its efficient development will have a big impact on all aeronautical personnel, including the managerial levels. That is why competence management is one of the key issues for a successful transition.

10.1.6 As a result of the introduction of the components of the ATM Operational Concept, new aeronautical disciplines will emerge. From the point of view of human resource planning, it will be necessary to redistribute and train personnel. The need for a seamless integration of human resources to the management of safety in the design and implementation of new ATM systems and in operational training has been clearly identified.

10.1.7 The planning of personnel competence management for the implementation of the components of the ATM Operational Concept shall take into account the specific requirements of all the implementation activity of the different areas that make up this Document. The development and implementation of the expertise of human resources, the guidelines, standards, methods and the tools for human error management, the friendly use of the new technology and operational training will be the basis for ATM success in the region.

10.1.8 The planning of training in the SAM Region shall be done in standardised manner and coordinated with CATCs where the required courses would be given.

10.1.9 ICAO has adopted a new training policy that includes a process to support training organisations and courses. This new training policy covers all safety and security aspects and supplements the work of the special team on the new generation of aviation professionals (NGAP). The civil aviation training policy of ICAO permits the implementation of an integral framework that ensures that all training provided by ICAO or third parties is subject to assessment to make sure it complies with the stringent standards concerning the design and development of training courses (EB2010/40).

10.2 Analysis of the current situation (2011)

10.2.1 The CAR/SAM ANP, within its planning parameters takes into account human resources and their training. The high level of automation and interdependence of the current system gives rise to several problems related to human resources and human factors and the interaction with their environment and other persons. The experience gained in this are indicates that the human element should be considered as the critical part of any plan for the implementation of new technologies. Achievement of the ATM operational concept will be dependent on the competence of the human resources.

10.2.2 The challenges and the development of human resources will multiply during the transition period to the ATM Operational Concept. Since the existing and emerging air navigation technologies will work in parallel for some time, civil aviation personnel will have to develop new skills while maintaining those necessary for the operation and maintenance of the existing systems, using a collaborative approach for civil aviation training.

10.2.3 The analysis of the current situation reveals existing weaknesses and emerging threats.

10.2.4 Weaknesses include, *inter alia*:

a) Lack of sufficient personnel;
b) Lack of and duly trained personnel;
c) Legal and budgetary limitations of the States;
d) High cost of training (initial, specialised, recurrent, remedial);
e) Personnel that do not comply with English language proficiency requirements;
f) Personnel with inadequate knowledge to manage operate and maintain the systems;
g) Inadequate and insufficient amount of simulators for training;
h) Instructors with insufficient knowledge and qualifications to meet current needs;
i) Insufficient civil aviation training centres (CATCs) with programmes and documentation, not meeting current needs;
j) Duplication of courses at regional institutes,
k) Insufficient evaluation at training centres in order to meet the established requirements in EB/2010/40;
l) Migration of professionals due to economical incentives;
m) Lack of criteria such as profiles, experience and/or specialty in the assignment of subjects teaching;
n) Lack of advantage takin regarding knowledge acquired as regards training and experience;
o) Lack of motivation regarding personal initiatives; and
p) Unsuitable mental model.

10.2.5 Emerging threats include *inter alia*,

a) Outdated training methods (external providers);
b) New technologies;
c) Increased and complex traffic volume;
d) Change of mindset to embrace a collaborative approach; and
e) Lack of communication among the various disciplines and the whole of the aeronautical community.

10.2.6 Currently, the South American Region has a regional mechanism made up by the Directors of Civil Aviation Training Centres, which meets on an annual basis. These events are aimed at analysing human resource planning and training, cooperation amongst training centres, the creation of introductory courses to the new systems, the need to professionalise training centres in order to face the new demands of the new systems, promote the TRAINAIR programme through the incorporation of new centres into the programme, and the development of courses under this methodology. This mechanism should reflect the new requirements, and establish a programme in keeping with current requirements.

10.2.7 To obtain a holistic view on the mater, the CATCs should integrate the training in the areas of aeronautical meteorology, safety and environment.

10.3 **Strategies for the implementation of performance objectives**

10.3.1 All the areas involved in ATM have participated in the planning of the development of human resources and training requirements, including operations and airworthiness personnel of the aeronautical authority of each State. The starting point was the absence of a full integration and the need to become aware of the role of each individual within the ATM Operational Concept, taking into account the guidelines of Document 9750 – Global Air Navigation Plan, the Global ATM Operational Concept (Doc. 9854) and other related ICAO documents.

10.3.2 In a first phase, the starting point should be known through the conduct of an analysis of the situation, to later develop a roadmap that includes concrete activities to face the challenges of the new concepts, with duly trained and updated personnel.

10.3.3 The Air Navigation system should be designed to reduce potential errors optimizing their detection and mitigation. To this end we need the application of a fair culture that includes a voluntary incident reporting system enabling organisational learning.

10.3.4 ICAO programmes concerning the formation of the new generation of aviation professionals (NGAP) must be taken into account, using the results of this panel for planning the courses.

10.3.5 To facilitate international cooperation for r the development of training programmes and materials the region may use the following strategies:

a) Early identification of training needs and priorities for Air Navigation Systems personnel: Given the diverse and specific training that will be needed for the new systems, as well as the need for standardization, it is essential to establish a collaborative plan of supplies required. However, an effective plan will only be formulated once the training needs and priorities have been clearly identified; and

b) Coordination and planning of training for Air Navigation Systems personnel at regional level: Effective planning and coordination in the preparation of the appropriate materials, avoiding duplication and7or absence of some formation and specialization courses. The SAM Region has structures that could be used to fulfil this task.

10.3.6 The civil aviation training centres should prepare their instructors, under a specific profile, on the ATM Operational Concept and the supporting systems for its implementation, such as ASBU.

10.3.7 When planning specialized training, provisions should be made for inclusion of basic training in other areas, so that there will be acknowledgement of the work carried out in other units, and awareness of the impact of the task in the consideration of the global ATM. Personnel will be aware of the work done in other units and of the impact their tasks have on the overall ATM. As a strategy, the planning of personnel competence management shall consider three stages:

a) Basic training: This stage shall include the new operational ATM concepts, the new communications, navigation and surveillance systems, the new aeronautical information vision, the meteorology system, safety and environment;
b) Training for those who plan and implement: Training is required at the top management level in order to provide decision makers the necessary basic information. This type of training is required for the ATM systems implementation planners; and
c) Task-specific training: Training is required for ongoing management, operation and maintenance of systems. This category accounts for most of the training needs and is the most difficult to develop and implement.

10.3.8 Planning has been based on a main axis, which is shown in **Attachment D**, and listed below:

a) Planning training to develop air navigation systems personnel skills (SAM HR/01 PFF).

10.3.9 CATCs shall actively accompany the planning and development of update and training courses on the ATM Operational Concept to comply with the roadmap outlined as per the ASBU methodology recommended by ICAO and the States,.

10.4 **Alignment with ASBU**

10.5 The development of human resources and competency management is an essential element for the implementation of all the ASBU modules taken under consideration (see Chapter 3). Therefore, SAM HR/01 PFF is related with the 18 modules selected for the SAM Region.

11. Chapter 11: Safety Management

11.1 Introduction

The Global Aviation Safety Plan

11.1.1 The 2014-2016 Global Aviation Safety Plan (GASP) (Doc. 10004) establishes specific safety objectives and initiatives, guaranteeing the efficient and effective coordination of safety-related complementary activities among all interested parties.

11.1.2 The purpose of GASP is to continuously reduce the global accident rate through a structured and progressive approach which comprises short, medium and long term objectives. As the Global Air Navigation Plan (GANP), the objectives of GASP are compatible through specific safety initiatives classified in accordance with the various safety performance areas. These performance areas are common to each of the global objectives.

11.1.3 The objectives of the ICAO GASP and their corresponding target dates are applied to the global aviation community. Nevertheless, each of these objectives includes specific initiatives and milestones that can be continuously implemented by States on the basis of their various operational profiles and priorities. In this manner, the initiatives in GANP will lead towards making progress as per each State's safety surveillance capabilities, the States Safety Programmes (SSP) and the safety processes necessary to support the future air navigation systems.

11.1.4 The first version of the ICAO GASP was prepared in 1997 and was regularly updated until 2005. The second edition was drafted in October 2007, which was subsequently acknowledged in Resolution A36-7. The cited Resolution A 36-7 urges contracting States and the industry to adopt the principles and objectives contained in the Global Aviation Safety Plan and the Global Aviation Safety Roadmap, and to apply their methodologies in partnership with all stakeholders with a view to reducing the number and rate of aircraft accidents.

Objectives of GASP

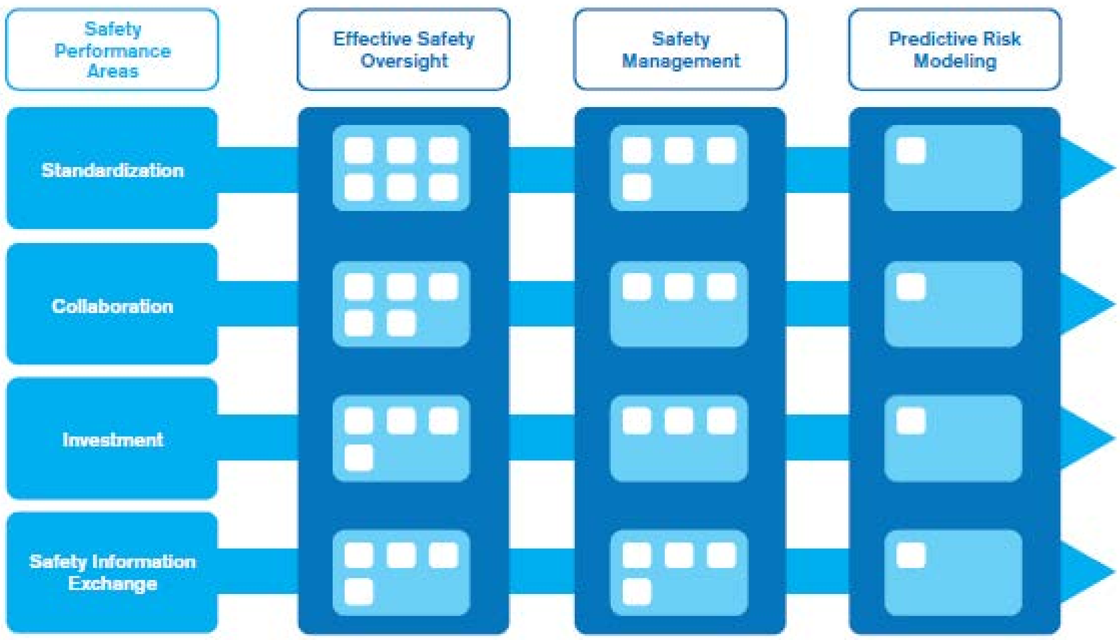
11.1.5 The short term objectives of GASP are oriented towards the implementation of the ICAO Standards and Recommended Practices (SARPs) related with State authorization, certification, and approval as they are pre-requisites enabling air traffic growth in a safe and sustainable manner. States lacking these capabilities will ensure they count with the resources, as well as with the legal, regulatory and organizational structures necessaries to comply with their fundamental obligations regarding safety surveillance. States having a mature safety surveillance system should centre in the continuous application of safety management in the short term. The target implementation of this objective is 2017.

11.1.6 The GASP medium term objective urges all States to achieve full implementation of SSP and Safety Management Systems (SMS) worldwide, to facilitate a dynamic management of the safety risks. Through the application of SSP, States will complement fundamental safety surveillance functions with the management of risks and analytical processes that can proactively identify and mitigate safety problems. The implementation target date is 2022.

11.1.7 The long term objective is the application of predictive systems to convert in the integral part of the future aviation systems. The objective is to support an operational environment defined by the increase of automation and the integration of ground and air advanced capabilities, as shown in the ASBU. The target date of this implementation is 2027.

Framework of GASP

11.1.8 The GASP can be mapped by using a safety strategic diagram, as the one shown in the figure below. This diagram shows how the safety initiatives and the GASP objectives joint to compose the safety improvement strategy.



11.1.9 The columns show the evolution of the Plan objectives. Every row represents the performance area that creates a common subject thread in support of GASP objectives.

Regional Aviation Safety Groups

11.1.10 The Regions are currently resolving safety issues through different mechanisms established by the States themselves and the industry. The Pan-American States created the Regional Aviation Safety Group— Pan-America (RASG-PA) in 2008 in response to Resolution A 36-7. This Group was established as a focal point to ensure harmonisation and coordination of safety efforts aimed at reducing aviation risks in the North American, Central American and Caribbean (NACC) and South American (SAM) Regions, and the promotion, by all the stakeholders, of the implementation of the resulting safety initiatives.

11.1.11 Current requirements on State safety management have been consolidated into Annex 19 – *Safety management*, adopted by the ICAO Council on 25 February 2013 and to become valid on 15 October 2013.

11.1.12 The State administration must establish mechanisms to ensure the effective supervision of the critical elements of the safety oversight function. Furthermore, it must create mechanisms to ensure that hazard identification and safety risk management by service providers is consistent with the established regulatory controls (requirements, specific operating regulations and implementation policies). These mechanisms include inspections, audits and surveys to ensure that safety risk regulatory controls are properly integrated in the SMS of service providers, that they are implemented as designed, and that they have the expected effect on safety risks.

State Safety Programme (SSP)

11.1.13 The introduction in the SARPs of requirements related to the State safety programme (SSP) resulted from the growing recognition that safety management principles impact most of the civil aviation management activities, including regulation, policy-making and safety oversight.

Safety Management System (SMS)

11.1.14 The States will require, as part of the State safety programme, that the air navigation service provider(s): ATS, AIS, CNS, MET, SAR y AGA implement a safety management system acceptable to the State and that, at least:

11.1.4.1. Identifies safety hazards;

11.1.4.2. Ensures the implementation of the necessary corrective measures to maintain the agreed level of safety efficacy;

11.1.4.3. Provides for ongoing monitoring and periodic assessment of safety efficacy; and 11.1.4.4. Seeks to improve the general status of the safety management system on a continuous basis.

11.1.15 The SMS will clearly define the lines of responsibility for safety within the organisation of the air navigation service provider, including the direct safety responsibility of high managerial staff.

11.1.16 When AIS, CNS, MET and/or SAR services are fully or partially provided by an entity other than an ATS provider, the requirements established in 11.1.5 and 11.1.6 will apply to those aspects of these services that a have direct operational impact.

11.1.17 In order to maintain acceptable safety levels, AIS and MET services must implement Quality Management Systems.

11.1.18 According to ICAO Annex 11, any significant change in the ATS system related to safety, including the implementation of reduced separation minima or a new procedure, will only become effective after a safety assessment has shown that they will meet an acceptable level of safety and that users have been consulted. When applicable, the responsible authority will make sure that the appropriate measures are taken for post-implementation monitoring to verify that the established level of safety is being met. When the acceptable level of safety cannot be expressed in quantitative terms due to the nature of the change, the safety assessment may rely on operational judgment.

11.2 **Current situation (2011)**

11.2.1 Since 2007, courses on safety management systems (SMS) have been dictated at a regional level and in all South American States. Also, since 2009, regional courses were dictated and in some States of the Region on State Safety Programmes (SSP) and in different forums SAM States have been encouraged to implement their SSP demanding implementation of the corresponding SMS to service providers.

11.2.2 In spite of the above, the results of the safety surveillance audits in the Region have demonstrated that few States have effectively implemented the ICAO SARPs in the ANS and AGA areas, being the Lack of Effective Implementation (LEI) in the Region of 48% in ANS and 36% in AGA, percentages that required be reduced to ensure the safety of operation in the region and satisfy the needs of GANP.

11.2.3 The region has a strategy of mutual support for the effective implementation of SARPs through a project of standardization of regulations, procedures and supporting documentation to the AAC to ensure safe implementation of the provisions contained in the GANP. This project is the development and implementation of the Latin American Aviation Regulations (LAR), which is supported by a regional project.

11.3 **Strategy for the Implementation of Performance Objectives**

11.3.1 Planning has been based on a main axis, as shown in **Attachment C**, called 'Safety" (SAM SM/01 PFF), as follows:

11.3.1.1 Safety Management (SAM SM/01 PFF).

12. Chapter 12: Performance Improvement Areas (PIA), modules and Air Navigation Report Forms (ANRF)

12.1 Introduction

12.1.1 This Chapter describes the Performance Improvement Areas (PIA) with the respective modules taken under consideration in ASBU Block 0 for the SAM Region. In addition, it presents a standard format for each of the modules considered, for the monitoring in their implementation. The format receives the name of Air Navigation Report Form (ANRF).

12.2 Performance Improvement Area (PIA)

12.2.1 Sets of modules in each block are grouped to provide operational and performance objectives in the environment to which they apply, thus forming executive high-level view of the intended evolution. The PIAs facilitate comparison of ongoing programmes.

12.2.2 The four performance improvement areas are as follows:

a) Airport operations
b) Globally Interoperable Systems and Data - Through Globally Interoperable System Wide Information Management
c) Optimum Capacity and Flexible Flights – Through Global Collaborative ATM
d) Efficient Flight Path – Through Trajectory-based Operations

Performance Improvement Area 1: Airport operations

12.2.3 In relation to airport operations, taking advantage of technical developments in air navigation and aircraft systems may assist in improving airport capacity and efficiency. In order to contribute to an overall strategy enhancing airport capacity, four related significant modules, were selected for inclusion in the ASBU framework:

a) B0-15 - *Improve Traffic Flow through Runway Sequencing (AMAN/DMAN)*;
b) B0-65 - *Optimization of Approach Procedures including Vertical Guidance*;
c) B0-75 - *Safety and Efficiency of Surface Operations (A-SMGCS Level 1-2)*; and
d) B0-80 - *Improved Airport Operations through Airport-CDM*.

12.2.4 The initial steps on these modules implement a combination of approach procedures making optimal usage of GNSS-based performance-based navigation (PBN) approaches and traffic flow improvements through the management of arrival and departure runway sequencing. New technology is already available to enhance the surveillance of aircraft surface movement, and may also provide information on suitably equipped vehicles. Improved processes are offered to support CDM involving all stakeholders on the airport.

12.2.5 Many of the operational improvements relating to airport capacity are local by essence and may only result in benefits at individual airports. Accordingly, improvements in airport capacity should be made on the basis of local decisions that take into account current and future aircraft operations and the level and type of equipage on board the aircraft. However, in cases where interdependencies in terms of traffic flows, airspace management and so forth exist between airport pairs, the full benefit of arrival/departure/surface management may only be achieved on a harmonized regional basis. The description of the modules chosen for this performance improvement area is presented as **Attachment D**.

Performance Improvement Area 2: Globally Interoperable Systems and Data - Through Globally Interoperable System Wide Information Management

12.2.6 The Global ATM Operational Concept envisages an integrated, harmonized and globally interoperable system for all users in all phases of flight. The aim is to increase user flexibility and maximize operating efficiencies while increasing system capacity and improving safety levels in the future ATM system.

12.2.7 In relation to globally interoperable systems and data two related significant modules, were selected for inclusion in the ASBU framework:

a) B0-25 - *Increased Interoperability, Efficiency and Capacity through Ground-Ground Integration*;
b) B0-30 - *Service Improvement through Digital Aeronautical Information Management;* and
c) B0-105 - *Meteorological information supporting enhanced operational efficiency and safety*.

12.2.8 At the first stage, these selected modules include the usage of automated ATS interfacility data communications (AIDC) messages as the basis of ground-ground coordination between neighboring ATS units contributing directly to safety improvements such as reductions in coordination errors and supports performance improvements such as reduced separation and enhanced efficiency.

12.2.9 Additionally the introduction of digital processing and management of information, through aeronautical information service (AIS)/aeronautical information management (AIM) implementation, use of aeronautical information exchange model (AIXM), migration to electronic aeronautical information publication (AIP) and better quality and availability of data contributes to the global interoperable systems and data. The description of the modules chosen for this performance improvement area is presented as Attachment D.

Performance Improvement Area 3: Optimum Capacity and Flexible Flights – Through Global Collaborative ATM

12.2.10 This performance improvement area is referred to the Optimum Capacity and Flexible Flights and in this sense 5 Modules were selected to be implemented in the SAM Region.

12.2.11 The modules are:

a) B-010 - *Improved Operations through Enhanced En-Route Trajectories*;
b) B-035 - *Improved Flow Performance through Planning based on a Network-Wide view*;
c) B-084 - *Initial capability for ground surveillance*;

d) B0-101 - *ACAS Improvements*; and
e) B-102 - *Increased Effectiveness of Ground-Based Safety Nets*.

12.2.12 These set of modules intend to optimize the use of airspace which would otherwise be segregated (i.e. special use airspace) along with flexible routing adjusted for specific traffic patterns managing Air Traffic Flow Management (ATFM) to minimize delay and maximize the use of the entire airspace.

12.2.13 It also considers the initial capability for lower cost ground surveillance supported by new technologies such as ADS-B OUT and wide area multilateration (MLAT) systems. This capability will be expressed in various ATM services, e.g. traffic information, search and rescue and separation provision.

12.2.14 In addition ground safety nets as short-term conflict alert, area proximity warnings and minimum safe altitude warnings are proposed as well as the MET information to support flexible airspace management, improved situational awareness and collaborative decision making, and dynamically- optimized flight trajectory planning.

Performance Improvement Area 4: Efficient Flight Path – Through Trajectory-based Operations

12.2.15 This performance improvement area is referred to the Efficient Flight Path and in this sense 3 Modules were selected to be implemented in the SAM Region.

12.2.16 The Modules are:

a) B0-05 - *Improved Flexibility and Efficiency in Descent Profiles (CDO)*;
b) B0-20 - *Improved Flexibility and Efficiency in Departure Profiles (CCO)*, and;
c) B0-40 - *Improved Safety and Efficiency through the initial application of Data Link En-Route*.

12.2.17 The cost impact for the selected modules is expected to be minimal and are anticipated to be borne predominantly by the air navigation service providers (ANSPs) on the basis that facilitating operator capabilities, such as performance-based navigation (PBN) and controller-pilot data link communications (CPDLC), are attributable to those programs rather than to CCO and CDO. Based on preliminary indications, the benefits of implementing these modules could be substantial for overall global system performance and, when implemented, the benefits are expected to far outweigh the costs.

12.3 **Air Navigation Report Forms (ANRF)**

12.3.1 This form provides a standardized approach to implementation monitoring and performance measurement of Aviation System Block Upgrades (ASBU) Modules. The Planning and Implementation Regional Groups (PIRGs) and States could use this report format for their planning, implementation and monitoring framework for ASBU Modules. Also, other reporting formats that provide more details may be used but should contain as a minimum the elements described below. The Reporting and monitoring results will be analysed by ICAO and aviation partners and then utilized in developing the Annual Global Air Navigation Report. The Global Air Navigation Report conclusions will serve as the basis for future policy adjustments aiding safety practicality, affordability and global harmonization, amongst other concerns. **Attachment E** presents the ANRF for each of the ASBU Block 0 modules taken under consideration in the SAM Region.

ATTACHMENT A

AIR TRAFFIC FORECASTS IN THE SAM REGION

TRAFFIC FLOW 1

- Buenos Aires – Santiago de Chile
- Buenos Aires – Sao Paulo/Rio de Janeiro
- Santiago de Chile – Sao Paulo/Rio de Janeiro
-

Rank	City Pair	Total Aircraft Movements 2007	Total Aircraft Movements 2027	Average Annual Growth(Per cent) 2007-2027
1	Santiago(Intl) - Buenos Aires(Pistarini)	12185	39079	6.0
2	Sao Paulo(Intl) - Buenos Aires(Pistarini)	11843	37982	6.0
3	Rio De Janeiro(Intl) - Buenos Aires(Pistarini)	5484	33681	9.5
4	Santiago(Intl) - Rio de Janeiro	4979	25453	8.5
5	Santiago(Intl) - Sao Paulo	846	4741	9.0
	TOTAL	35337	140936	7.2

- Sao Paulo/Rio de Janeiro – Europe

Rank	City Pair	Total Aircraft Movements 2007	Total Aircraft Movements 2027	Average Annual Growth(Per cent) 2007-2027
1	Sao Paulo-Paris	2921	8523	5.5
2	Sao Paulo-London	1665	5867	6.5
3	Rio De Janeiro-Paris	1559	6033	7.0
4	Sao Paulo-Madrid	1543	3721	4.5
5	Sao Paulo-Frankfurt	1521	3668	4.5
6	Sao Paulo-Milan	1284	4969	7.0
7	Rio De Janeiro-Madrid	1112	2213	3.5
8	Sao Paulo-Lisbon	992	2894	5.5
9	Rio De Janeiro-Lisbon	943	3323	6.5
10	Sao Paulo-Johannesburg	878	3094	6.5
11	Santiago-Rio De Janeiro	846	4741	9.0
12	Sao Paulo-Amsterdam	730	1761	4.5
13	Sao Paulo-Munich	726	2118	5.5
14	Zurich-Sao Paulo	676	1221	3.0
15	Rio De Janeiro-Porto	304	593	3.4
16	Sao Paulo-Porto	302	589	3.4
17	Rio De Janeiro-Frankfurt	190	371	3.4
18	Rio De Janeiro-Milan	16	31	3.4
19	Sao Paulo-Rome	2	4	3.4
	Total	18210	55734	5.8

TRAFFIC FLOW 2

- Sao Paulo/Rio de Janeiro – Miami
- Sao Paulo/Rio de Janeiro – New York

Rank	City Pair	Total Aircraft Movement 2007	Total Aircraft Movements 2027	Average Annual Growth(Per cent) 2007-2027
1	Rio de Janeiro-Miami	1082	1954	3.0
2	Sao Paulo- new York (Newark)	362	979	5.1
3	Sao Paulo-Miami	3482	6289	3.0
3	Sao Paulo-New York(JFK)	3233	5839	3.0
5	Sao Paulo-new York(Newark)	362	979	5.1
	Total	8521	16040	3.2

TRAFFIC FLOW 3

- Sao Paulo/Rio de Janeiro — Lima
- Sao Paulo/Rio de Janeiro — Los Angeles

Rank	City Pair	Total Aircraft Movements 2007	Total Aircraft Movements 2027	Average Annual Growth(Per cent) 2007-2027
1	Sao Paulo-Lima	2596	15944	9.5
2	Sao Paulo-Los Angeles	182	492	5.1
	Total	2778	16436	9.3

TRAFFIC FLOW 4

- Santiago — Lima — Miami
- Buenos Aires — New York
- Buenos Aires — Miami

Rank	City Pair	Total Aircraft Movements 2007	Total Aircraft Movements 2027	Average Annual Growth(Per cent) 2007-2027
1	Buenos Aires - New York	835	2258	5.1
2	Buenos Aires - Miami	2652	7172	5.1
3	Santiago - Lima	4208	21511	8.5
4	Lima - Miami	2220	6004	5.1
5	Santiago - Miami	1781	4816	5.1
	Total	11696	41761	6.6

TRAFFIC FLOW 5

- North of South America – Europe

Rank	City Pair	Total Aircraft Movements 2007	Total Aircraft Movements 2027	Average Annual Growth (Per cent) 2007-2027
1	Madrid - Bogota	1830	7774	7.5
2	Madrid - Caracas	1639	6342	7.0
3	Madrid - Lima	1323	3934	5.6
4	Madrid - Guayaquil	1099	3268	5.6
5	Paramaribo - Amsterdam	754	2242	5.6
6	Paris - Bogota	730	1318	3.0
7	Paris - Caracas	724	2322	6.0
8	Paris(Orly) - Cayenne	719	2782	7.0
9	Frankfurt - Caracas	676	2872	7.5
10	Milan - Caracas	520	1230	4.4
11	Quito - Madrid	519	1228	4.4
12	Lima - Amsterdam	493	1166	4.4
13	Lisbon - Caracas	434	1027	4.4
14	Santa Cruz - Madrid	433	1024	4.4
15	Funchal - Caracas	242	573	4.4
16	Madrid - Cali	227	537	4.4
17	Rome - Caracas	210	497	4.4
18	Porlamar - Frankfurt	209	494	4.4
19	Bogota - Barcelona	157	371	4.4
20	Tenerife - Caracas	110	260	4.4
21	Porto - Caracas	104	246	4.4
22	Porlamar - London	94	222	4.4
23	Bogota - Alicante	52	123	4.4
24	Porlamar - Manchester	48	114	4.4
25	Porlamar - Amsterdam	47	111	4.4
	Total above routes	13393	42079	5.9
	All other routes	58	137	4.4
	TOTAL	13451	42216	5.9

TRAFFIC FLOW 6

Santiago — Lima — Los Angeles

Rank	City Pair	Total Aircraft Movements 2007	Total Aircraft Movements 2027	Average Annual Growth(Per cent) 2007-2027
1	Santiago - Lima	4208	21511	8.5
2	Los Angeles - Lima	1155	3123	5.1
3	Santiago - Los Angeles	304	822	5.1
	Total	5667	25457	7.8

TRAFFIC FLOW 7

- South America — South Africa

Rank	City Pair	Total Aircraft Movements 2007[2/]	Total Aircraft Movements 2027	Average Annual Growth(Per cent) 2007-2027
1	Sao Paulo - Johannesburg	878	3094	6.5
2	Buenos Aires - Cape Town	208	406	3.4
	Total	1086	3500	6.0

- Santiago de Chile — Easter Island — Papeete (PAC)

Rank	City Pair	Total Aircraft Movements 2007	Total Aircraft Movements 2027	Average Annual Growth(Per cent) 2007-2027
1	Santiago - Easter Island	499	1456	5.5
2	Easter Island - Papeete	209	504	4.5
	Total	708	1960	5.2

Tabla 1a: Sudamérica – Movimiento de Pasajeros

	Year	Passengers (Million)	Load Factor	Average Seats
Historical	1997	4.3	64.7	170
	2003	7.11	60.9	160
	2004	8.03	64.6	160
	2005	9.78	73.5	168
	2006	10.81	70.9	167
	2007	13.55	74.1	164
Forecast	2012	22.74	74.1	168
	2017	35.5	77	172
	2027	73.65	80	180
Average Annual Growth (Per cent)	1997-2007	12.2	1.4	-0.4
	2007-2012	10.9	0	0.5
	2012-2017	9.3	0.8	0.5
	2007-2027	8.8	0.4	0.5

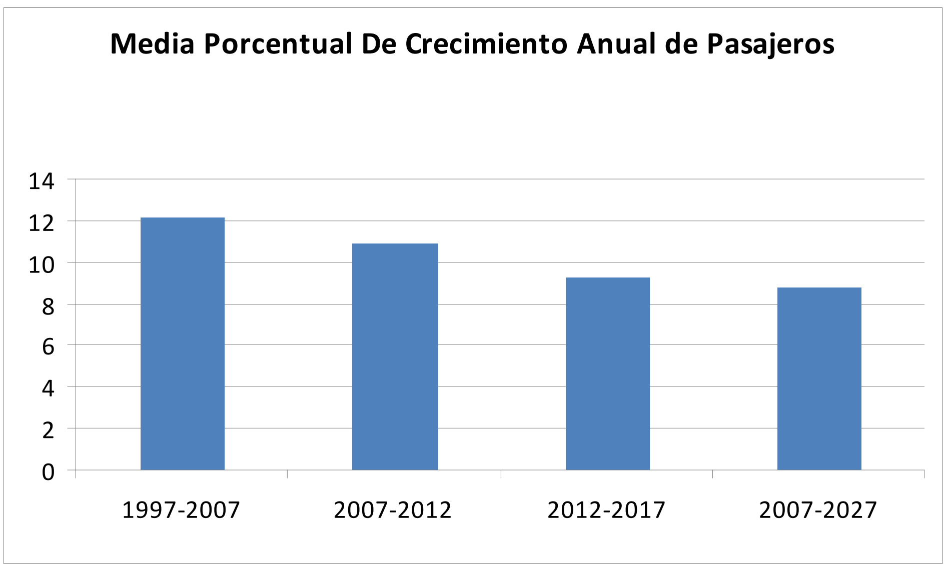
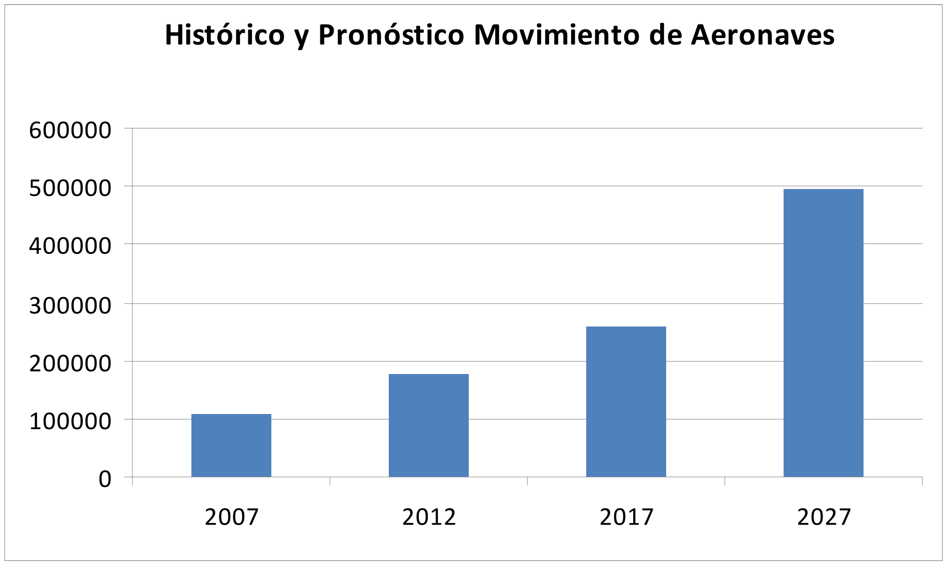


Tabla 1b: Sudamérica – Movimiento de Aeronaves

	Year	Aircraft Movements
Historic	2007	108523
Forecast	2012	177515
	2017	260507
	2027	497008
Average Annual Growth (Per cent)	2007-2012	10.3
	2012-2017	8
	2007-2027	7.9


Histórico y Pronóstico Movimiento de Aeronaves
600000
500000
400000
300000
200000
100000
0
2007
2012
2017
2027

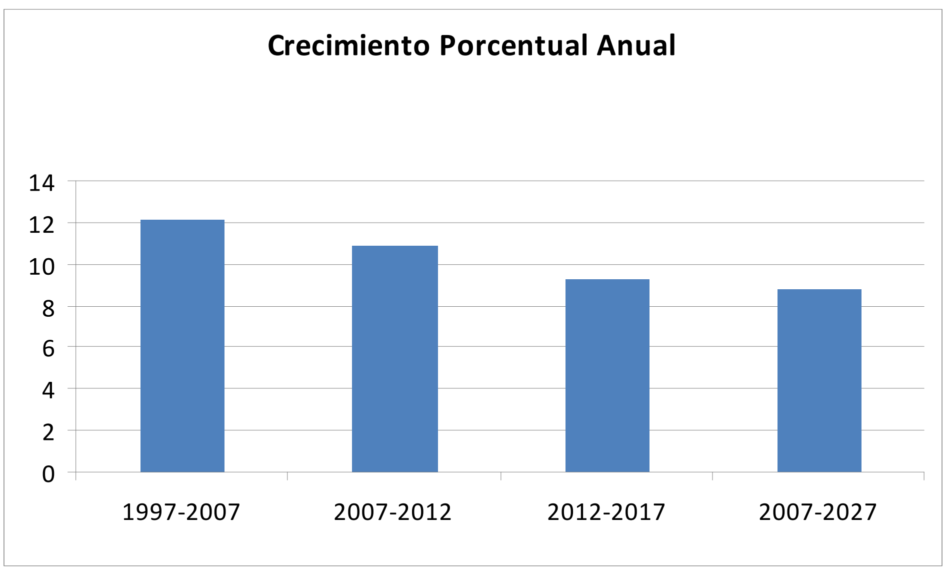
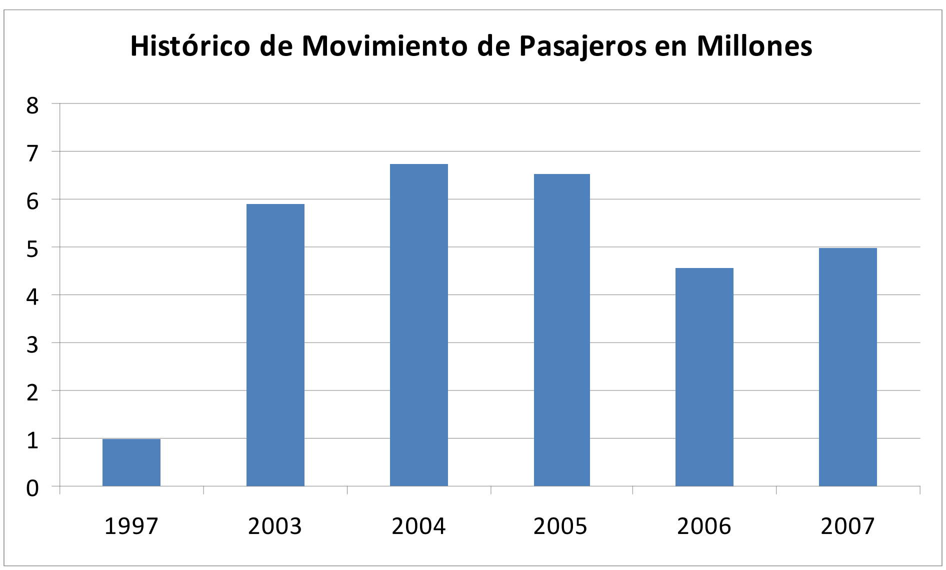

Crecimiento Porcentual Anual
14
12
10
8
6
4
2
0
1997-2007
2007-2012
2012-2017
2007-2027

Tabla 2a: Sudamérica – Centro América – Movimiento de Pasajeros

	Year	**Passengers (Million)**	**Load Factor**	**Average Seats**
Historical	1997	1.02	54	165
	2003	5.93	4.1	162
	2004	6.77	4.81	161
	2005	6.56	4.59	157
	2006	4.59	70	157
	2007	4.98	72.4	156
Forecast	2012	7.93	72.4	157
	2017	11.91	74.8	158
	2027	27.32	80	160
Average Annual Growth (Per cent)	1997-2007	17.2	3	-0.5
	2007-2012	9.7	0	0.1
	2012-2017	8.5	0.7	0.1
	2007-2027	8.9	0.5	0.1



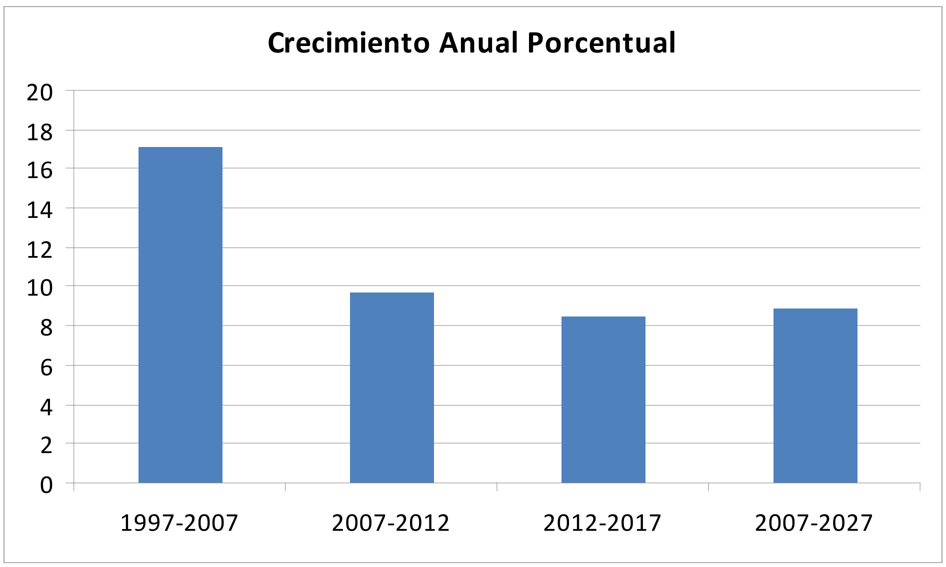
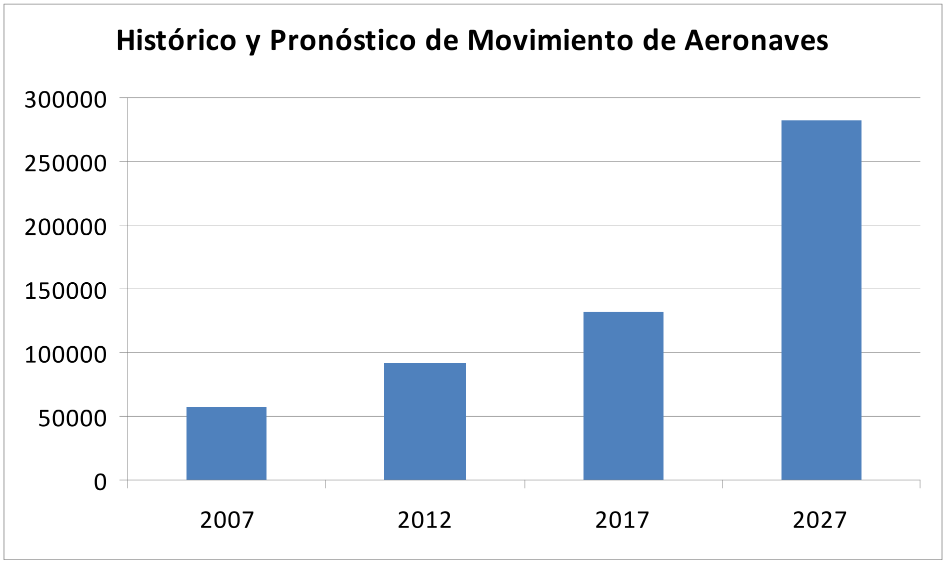


Tabla 2b: Sudamérica – Centro América -Movimiento de Aeronaves

	Year	**Aircraft Movements**
Historic	2007	58378
Forecast	2012	92446
	2017	133450
	2027	282354
Average Annual Growth (per cent)	2007-2012	9.6
	2012-2017	7.6
	2007-2027	8.2


Histórico y Pronóstico de Movimiento de Aeronaves
300000
250000
200000
150000
100000
50000
0
2007
2012
2017
2027

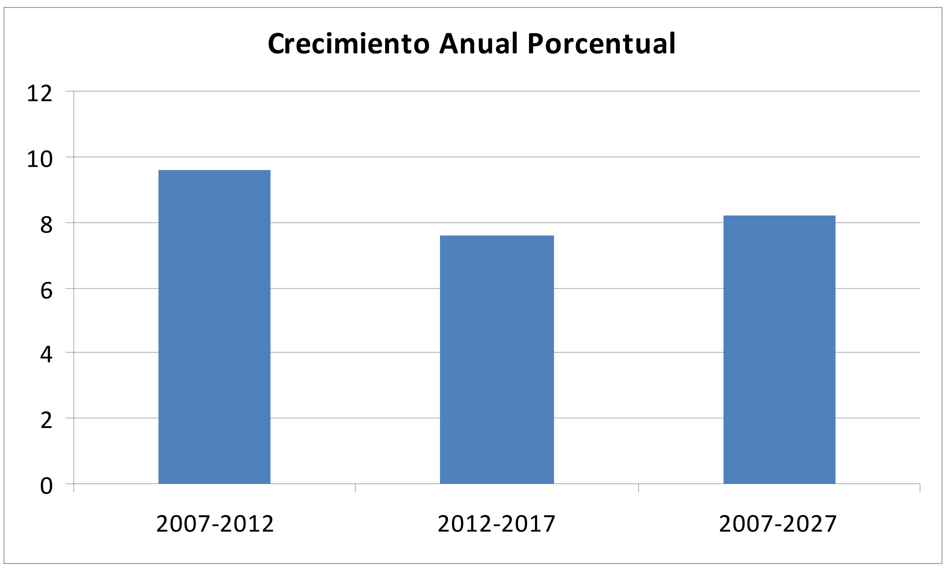
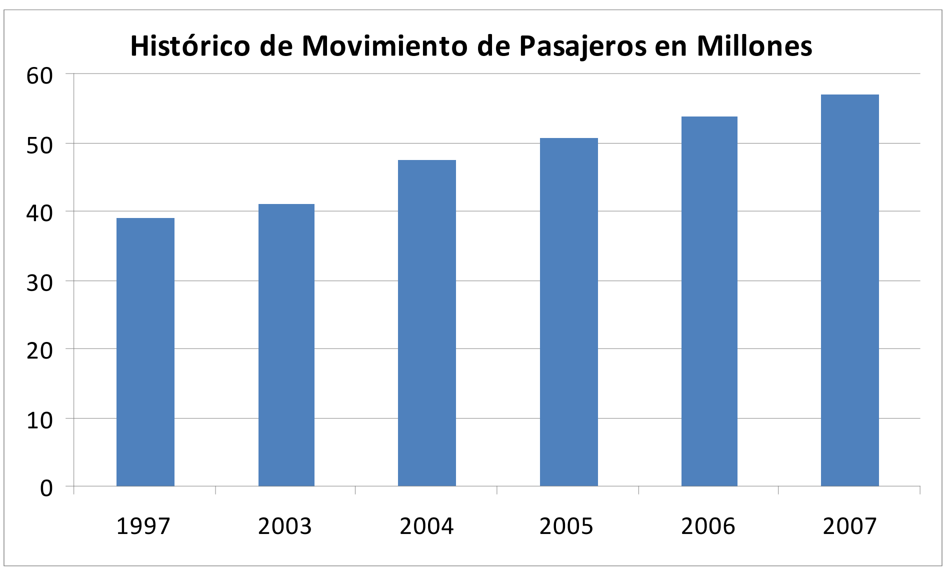
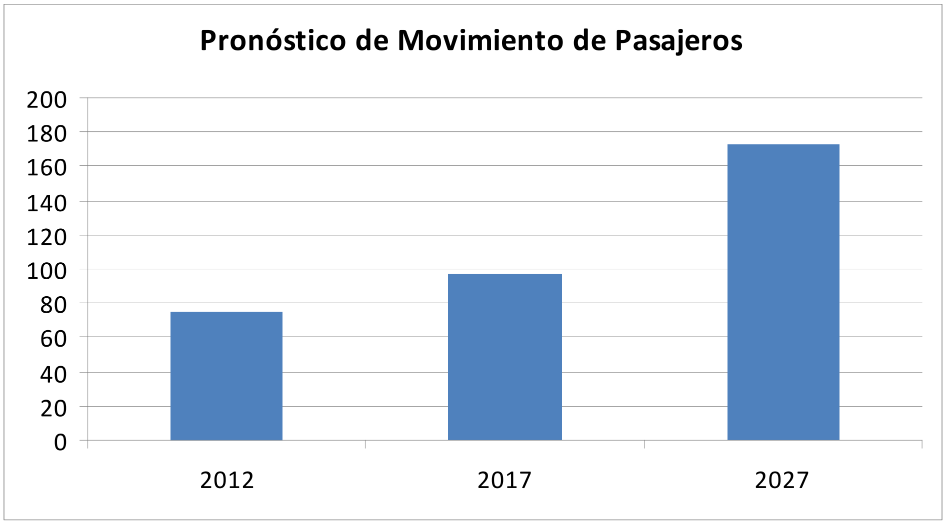

Crecimiento Anual Porcentual
12
10
8
6
4
2
0
2007-2012
2012-2017
2007-2027

Tabla 3a: Sudamérica – Norteamérica Movimiento de Pasajeros

	Year	Passengers (Million)	Load Factor	Average Seats
Historical	1997	39.2	62	189
	2003	41.23	68	168
	2004	47.42	70	166
	2005	50.83	73	166
	2006	53.88	74.4	166
	2007	56.96	76.6	166
Forecast	2012	75.66	76.6	165
	2017	97.58	79.3	167
	2027	172.97	85	170
Average Annual Growth (Per cent)	1997-2007	3.8	2.1	-1.3
	2007-2012	5.8	0	-0.1
	2012-2017	5.2	0.7	0.2
	2007-2027	5.7	0.5	0.1




Pronóstico de Movimiento de Pasajeros
200
180
160
140
120
100
80
60
40
20
0
2012
2017
2027

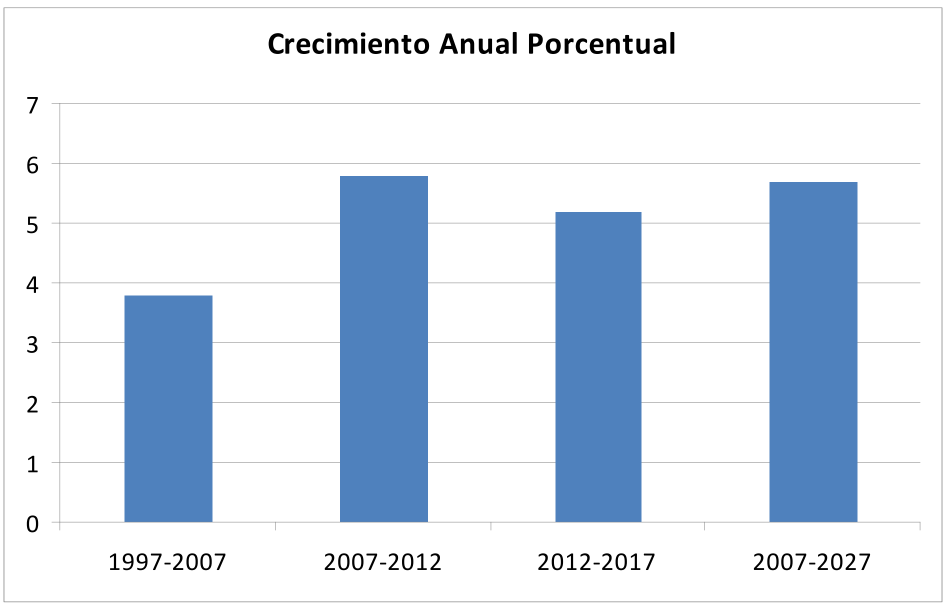
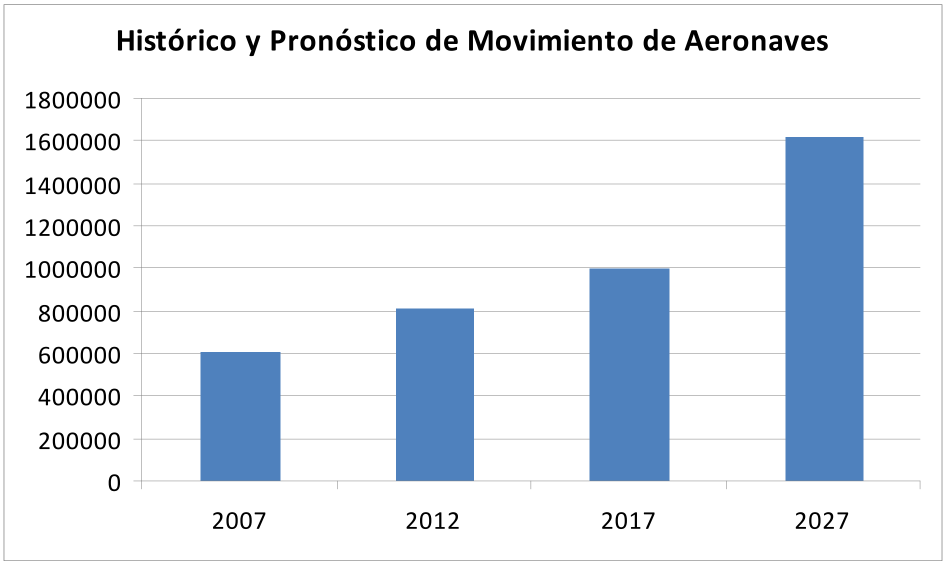

Crecimiento Anual Porcentual
7
6
5
4
3
2
1
0
1997-2007
2007-2012
2012-2017
2007-2027

Tabla 3b: Sudamérica – Norteamérica Movimiento de Aeronaves



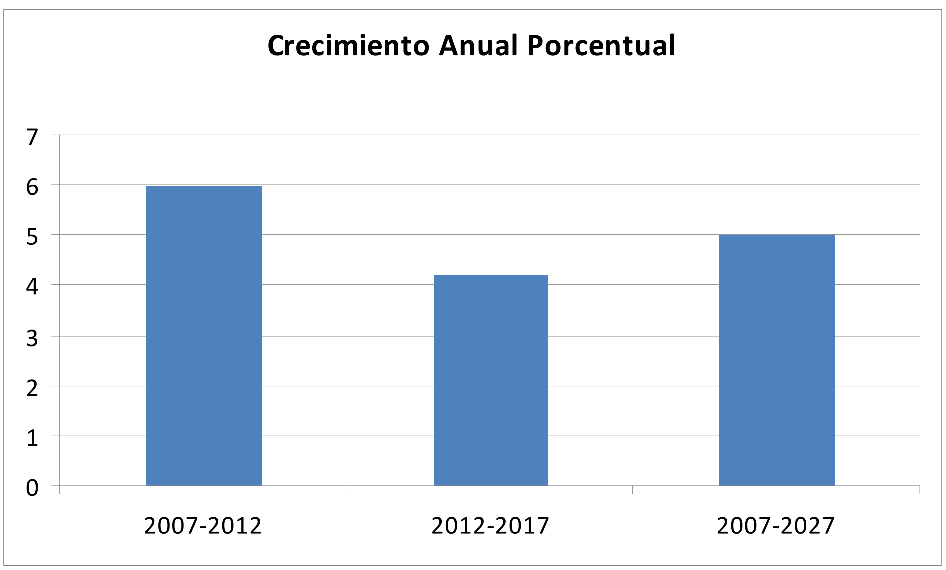
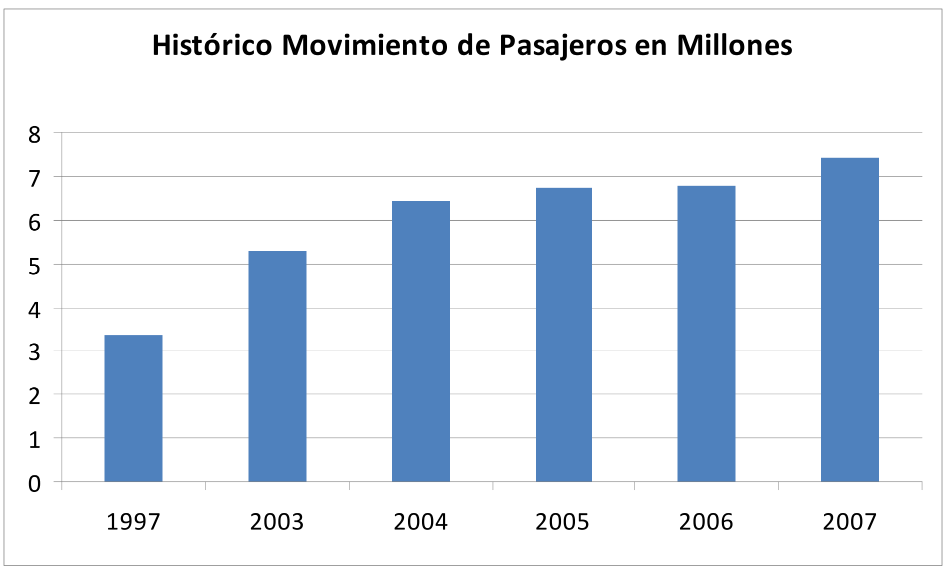
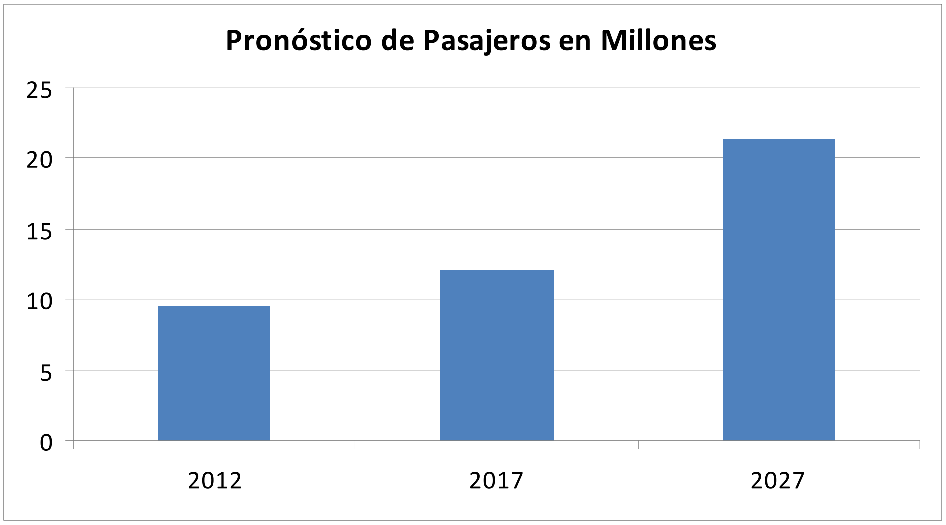


Tabla 4a: Atlántico Sur Corredor Europeo Sudamérica – Pasajeros

	Year	Passengers (Million)	Load Factor	Average Seats
Historical	1997	3.4	74.4	287
	2003	5.3	77	309
	2004	6.43	76	339
	2005	6.77	79.6	325
	2006	6.79	84.3	286
	2007	7.46	83.7	281
Forecast	2012	9.6	83.7	281
	2017	12.12	85	281
	2027	21.48	85	280
Average Annual Growth (Per cent)	1997-2007	8.2	1.2	0.3
	2007-2012	5.2	0	-0.6
	2012-2017	4.8	0.3	0
	2007-2027	5.4	0.1	-0.2





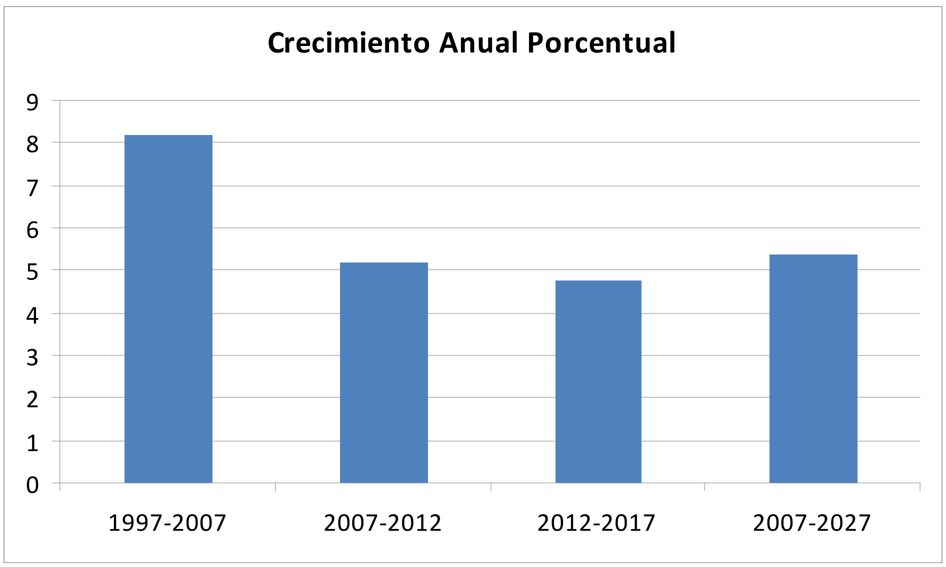
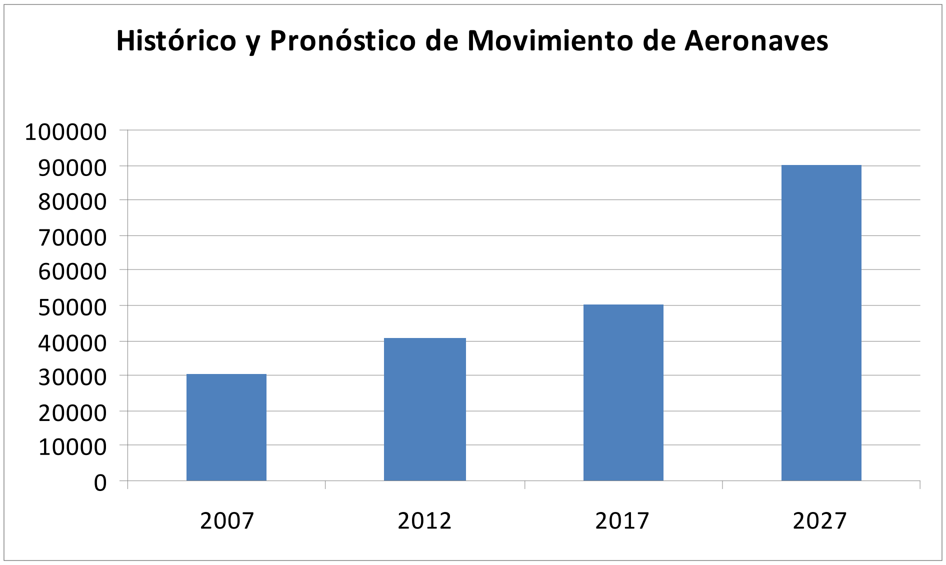
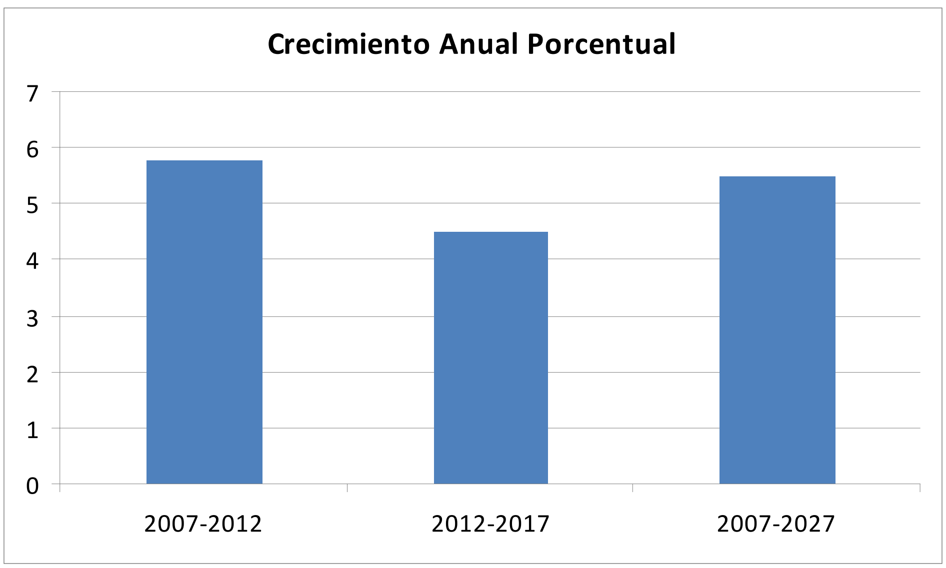


Tabla 4b: Atlántico Sur Corredor Europeo Sudamérica -Aeronaves

	Year	**Aircraft Movements**
Historic	2007	30749
Forecast	2012	40805
	2017	50732
	2027	90252
Average Annual Growth	2007-2012	5.8
(Per cent)	2012-2017	4.5
	2007-2027	5.5


Histórico y Pronóstico de Movimiento de Aeronaves
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
2007
2012
2017
2027


Crecimiento Anual Porcentual
7
6
5
4
3
2
1
0
2007-2012
2012-2017
2007-2027

ATTACHMENT B

GLOBAL PLAN INITIATIVES AND THEIR RELATIONSHIP WITH THE MAIN GROUPS

GPI		En-route	Terminal Area	Aerodrome	Ancillary Infrastructure	Associated component of the Operational Concept
GPI-1	Flexible use of airspace	X	X			AOM, AUO
GPI-2	Reduced vertical separation minima	X				AOM, CM
GPI-3	Harmonisation of level systems	X				AOM, CM, AUO
GPI-4	Alignment of upper airspace classifications	X				AOM, CM, AUO
GPI-5	RNAV and RNP (Performance-based navigation)	X	X	X		AOM, AO, TS, CM, AUO
GPI-6	Air traffic flow management	X	X	X		AOM, AO, DCB, TS, CM, AUO
GPI-7	Dynamic and flexible ATS route management	X	X			AOM, AUO
GPI-8	Collaborative airspace design and management	X	X			AOM, AUO
GPI-9	Situational awareness	X	X	X	X	AO, TS, CM, AUO
GPI-10	Terminal area design and management		X			AOM, AO, TS, CM, AUO
GPI-11	RNP and RNAV SIDs and STARs		X			AOM, AO, TS, CM, AUO
GPI-12	Functional integration of ground and airborne systems		X		X	AOM, AO, TS, CM, AUO
GPI-13	Aerodrome design and management			X		AO, CM, AUO
GPI-14	Runway operations			X		AO, TS, CM, AUO
GPI-15	Match IMC and VMC operating capacity		X	X	X	AO, CM, AUO
GPI-16	Decision support and alerting systems	X	X	X	X	DCB, TS, CM, AUO

GPI		En-route	Terminal Area	Aerodrome	Ancillary Infrastructure	Associated component of the Operational Concept
GPI-17	Implementation of data Relationship applications	X	X	X		DCB, AO, TS, CM, AUO, ATMSDM
GPI-18	Aeronautical information	X	X	X	X	AOM, DCB, AO, TS, CM, AUO, ATMSDM
GPI-19	Meteorological systems	X	X	X	X	AOM, DCB, AO, AUO
GPI-20	WGS-84	X	X	X	X	AO, CM, AUO
GPI-21	Navigation systems	X	X	X	X	AO, TS, CM, AUO
GPI-22	Communication infrastructure	X	X	X	X	AO, TS, CM, AUO
GPI-23	Aeronautical radio spectrum	X	X	X	X	AO, TS, CM, AUO, ATMSDM

ATTACHMENT C

PERFORMANCE FRAMEWORK FORM (PFF)

1. This outcome and management form is applicable to both regional and national planning, and includes references to the Global Plan. Other formats may be appropriate, but they must contain, at least, the elements described below.

1.1 **Performance objective:** Regional/national performance objectives should be defined, using the performance-based approach that best reflects the activities required to support ATM systems at regional/national level. Along their life cycle, performance objectives may change, depending on the evolution of the ATM system; therefore, during the implementation process, they should be coordinated with all the stakeholders in the ATM community and be at their disposal. The establishment of joint decision-making processes ensures that all stakeholders are involved and agree on the requirements, tasks and timetables.

1.2 **Regional performance objectives:** Regional performance objectives are the improvements required by the air navigation system to support global performance objectives, and are related to the operational environments and the priorities applicable at regional level.

1.3 **National performance objectives:** National performance objectives are the improvements required by the air navigation system in support of regional performance objectives, and are related to the operational environments and priorities applicable at State level.

1.4 **Benefits:** Regional/national performance objectives should meet the expectations of the ATM community, as described in the operational concept; they should generate benefits for the parties involved; and should be attained through operational activities and techniques aligned with each performance objective.

1.5 **Metrics:** Metrics permit to measure the objectives achieved. The monitoring and measurement of the performance of ATM systems may require metrics in areas such as access, capacity, cost-effectiveness, efficiency, environment, flexibility, prediction capacity, and safety.

1.6 **Strategy:** ATM evolution requires a clearly-defined gradual strategy that includes the tasks and activities that best represent the national and regional planning processes, in keeping with the global planning framework. The goal is to achieve a harmonised implementation process that evolves towards a global and seamless ATM system. Accordingly, it is necessary to develop short- and medium-term work programmes focused on system improvements that reflect a clear work commitment of the parties involved.

1.7 **Components of the ATM operational concept:** Each strategy or set of tasks should be associated to components of the ATM operational concept. The designators of the ATM components are as follows:

- AOM – Airspace organisation and management
- DCB – Demand/capacity balancing
- AO – Aerodrome operations

- TS – Traffic synchronisation
- CM – Conflict management
- AUO – Airspace user operations
- ATM SDM – ATM service delivery management

1.8 **Tasks:** The regional/national work programmes, based on these PFF templates, should define the tasks required to attain said performance objective while maintaining a direct relationship with the components of the ATM system. The following principles should be taken into account when developing a work programme:

- Work should be organised using project management techniques and performance-based objectives, in line with ICAO strategic objectives.
- All tasks related to the compliance with the performance objectives should be carried out based on strategies, concepts, action plans and roadmaps that may be shared amongst the parties, with the main objective of attaining transparency through interoperability and harmonisation.
- Task planning should include the optimisation of human resources, as well as the promotion of the dynamic use of electronic communication amongst the parties (for example, Internet, video-conferences, tele-conferences, e-mail, telephone and fax). Likewise, resources should be used efficiently, avoiding duplication of work or unnecessary tasks.
- The process and work methods should ensure the possibility of measuring the performance objectives, comparing them with timetables, and easy reporting of the progress made at national and regional level to the PIRGs and ICAO Headquarters, respectively.

1.9 **Period:** Indicates the start and end of that task in particular.

1.10 **Responsibility:** Indicates the organisation/entity/individual responsible for the fulfilment or management of the associated tasks.

1.11 **Status:** The status basically monitors progress in the fulfilment of said task as it proceeds to the date of completion. For the classification of the status of implementation, the words VALID, COMPLETED, REPLACED and CONTINUOUS will be used.

1.12 **Link with the global plan initiatives (GPIs)*:*** The 23 GPIs, as described in the Global Plan, provide a global strategic framework for the planning of air navigation systems, and are designed to contribute to the achievement of regional/national performance objectives. Each performance objective should be related with the corresponding GPIs. The goal is to make sure that the evolutionary work process at State and regional level is integrated within the global planning framework.

2. The PFFs prepared for the performance objectives concerning ATM, CNS, MET, SAR, AIS, AGA/AOP, personnel competence management and SMS are presented below. In addition, a matrix with the inter-relationship amongst the PFFs in included.

<table>
<tr><td colspan="5" align="center">REGIONAL PERFORMANCE OBJECTIVE: <u>SAM ATM/01</u>
OPTIMISATION OF THE EN-ROUTE AIRSPACE STRUCTURE</td></tr>
<tr><td colspan="5" align="center">Benefits</td></tr>
<tr><td>Safety</td><td colspan="4">• Reduces the complexity of the airspace structure, by reinforcing safety</td></tr>
<tr><td>Environmental protection and sustainable development of air transport</td><td colspan="4">• Reduces fuel consumption and, consequently, CO^2 emissions into the atmosphere, due to reduction of miles flown and to continuous descent and ascent operations
• Increases airspace capacity.
• Takes advantage of aircraft RNAV capacity</td></tr>
<tr><td colspan="5" align="center">Metrics</td></tr>
<tr><td colspan="5">• Reduction of air traffic incidents each 100,00 operations per year
• Increase ATC sector capacity
• Reduction of CO^2 emissions each 100,00 operations per year</td></tr>
<tr><td colspan="5" align="center">2012 - 2018
Strategy</td></tr>
<tr><th>ATM OC COMPONENTS</th><th>TASKS</th><th>PERIOD</th><th>RESPONSIBILITY</th><th>STATUS</th></tr>
<tr><td rowspan="8"></td><td>a) Carry out implementation and assessment of Version 02 of the SAM ATS route network, and the implementation of RNAV 5 exclusionary space.</td><td>(*) - 2013</td><td>States</td><td>Valid</td></tr>
<tr><td>b) Optimise oceanic routes and complete implementation of RNAV10 (RNP10) routes.</td><td>(*) - 2012</td><td>States</td><td>Valid</td></tr>
<tr><td>c) Review and update the SAM PBN Roadmap and the ATS route network optimisation programme.</td><td>2012 - 2013</td><td>Regional Project
States</td><td>Valid</td></tr>
<tr><td>d) Assess the status of implementation of the en-route PBN action plan.</td><td>2012</td><td>States</td><td>Valid</td></tr>
<tr><td>e) Implement a regional tool for RAI availability forecast in order to support en-route, TMA and non-precision approach operations.</td><td>2012 - 2015</td><td>States</td><td>Valid</td></tr>
<tr><td>f) Prepare Version 03 of the ATS route network, including RNP4 application for oceanic routes and RNP2 in continental airspace.</td><td>2015</td><td>Regional Project
States</td><td>Valid</td></tr>
<tr><td>g) Implement random routes in defined continental airspaces.</td><td>2018+</td><td>States</td><td>Valid</td></tr>
<tr><td>h) Monitor implementation progress.</td><td>(*) - 2018 +</td><td>GREPECAS</td><td>Valid</td></tr>
<tr><td>Relation-ship with GPIs</td><td colspan="4">GPI/5: performance-based navigation, GPI/7: management of dynamic and flexible ATS routes, GPI/8: collaborative airspace design and management.</td></tr>
</table>

(*) Indicates that the task has started before the date contemplated in this planning.

<table>
<tr><td colspan="5">REGIONAL PERFORMANCE OBJECTIVE: <u>SAM ATM/02</u>
TMA AIRSPACE STRUCTURE OPTIMISATION</td></tr>
<tr><td colspan="5">Benefits</td></tr>
<tr><td>Safety</td><td colspan="4">• Implementation of continuous descent (CDO) operations
• Increased safety during landing and reduced CFIT incidence
• Reduction of airspace complexity, by reinforcing safety</td></tr>
<tr><td>Environmental protection and sustainable development of air transport</td><td colspan="4">• Reduces fuel consumption and, consequently, CO^2 emissions into the atmosphere, due to reduction of miles flown and continuous descent and ascent operations;
• Reduces aeronautical noise, through continuous descent operations (CDO);
• Increases airspace capacity, since it permits the establishment of separate arrival/departure flows, and even the segregation of IFR from VFR flights;
• Takes advantage of aircraft RNAV capacity;
• Airport arrival/departure under any meteorological condition.</td></tr>
<tr><td colspan="5">Metrics</td></tr>
<tr><td colspan="5">• Percentage of international aerodromes with SIDs/STARs, RNAV and/or RNP implemented, when required.
• Percentage of aerodromes that have implemented continuous descent and ascent operations.
• Reduction of air traffic incidents each 100,00 operations per year
• Reduction of tons of CO^2 emissions each 100,00 operations per year
• Reduction of aeronautical noise.</td></tr>
<tr><td colspan="5">2012 - 2018
Strategy</td></tr>
<tr><td>ATM OC COMPONENTS</td><td>TASKS</td><td>PERIOD</td><td>RESPONSIBILITY</td><td>STATUS</td></tr>
<tr><td rowspan="6">AOM
AUO
CM</td><td>a) Assess the progress made in the terminal area PBN action plan.</td><td>2012</td><td>States</td><td>Valid</td></tr>
<tr><td>b) Implement standard RNAV 1 arrival/departure routes in selected TMAs with ATS surveillance.</td><td>(*) - 2013</td><td>States</td><td>Valid</td></tr>
<tr><td>c) Implement RNAV 1 and/or RNP 1 standard arrival/departure routes in all the TMAs of international airports.</td><td>2012 – 2016</td><td>States</td><td>Valid</td></tr>
<tr><td>d) Implement CDO operations in all the TMAs of international airports.</td><td>2013 - 2018</td><td>States</td><td>Valid</td></tr>
<tr><td>e) Implement RNAV1/RNP1 exclusionary airspace in high-density TMAs.</td><td>2015 – 2018 +</td><td>States</td><td>Valid</td></tr>
<tr><td>f) Monitor progress during implementation.</td><td>(*) - 2018</td><td>GREPECAS</td><td>Valid</td></tr>
<tr><td>Relation-ship with GPIs</td><td colspan="4">GPI/1: Flexible use of airspace, GPI/5: performance-based navigation, GPI/7: management of dynamic and flexible ATS routes, GPI/8: collaborative airspace design and management, GPI/10: terminal area design and management, GPI/11: RNP and RNAV SIDs and STARs, and GPI/12: functional integration of ground and airborne systems.</td></tr>
</table>

(*) Indicates that the task has been started before the period contemplated in this planning.

<table>
<tr><td colspan="5">REGIONAL PERFORMANCE OBJECTIVE: <u>SAM ATM/03</u>
IMPLEMENTATION OF RNP APPROACHES</td></tr>
<tr><td colspan="5">Benefits</td></tr>
<tr><td>Safety</td><td colspan="4">• Increases safety during landing, reducing the incidence of CFIT
• Permits the establishment of safe approach procedures at airports with limitations due to rough terrain.</td></tr>
<tr><td>Environmental protection and sustainable development of air transport</td><td colspan="4">• Reduces miles flown and/or permits optimum descent flights, decreasing fuel consumption, and thus CO^2 emissions into the atmosphere;
• Takes advantage of aircraft capacity for flying optimum paths;
• Improved airport operational minima.</td></tr>
<tr><td colspan="5">Metrics</td></tr>
<tr><td colspan="5">• Percentage of RNP APCH procedures that have been implemented, including APV Baro VNAV and LNAV implemented only at runway ends with instrument operations, according to the 37th Assembly Resolution 37/11.</td></tr>
<tr><td colspan="5">2012 - 2018
Strategy</td></tr>
<tr><td>ATM OC COMPONENTS</td><td>TASKS</td><td>PERIOD</td><td>RESPONSIBILITY</td><td>STATUS</td></tr>
<tr><td rowspan="4">AOM
AUO
AO
CM</td><td>a) Assess progress of PBN action plan on approach procedures.</td><td>2012</td><td>SAMIG</td><td>Valid</td></tr>
<tr><td>b) Implement RNP APCH procedures (or RNP AR APCH when operationally advantageous), including APV BARO VNAV, and LNAV only, in conformity with ICAO Assembly Resolution A37/11.</td><td>(*) – 2018+</td><td>States</td><td>Valid</td></tr>
<tr><td>c) Start-up of the implementation of GLS procedures (GBAS) CAT I landing at selected airports.</td><td>2015 – 2018 +</td><td>States</td><td>Valid</td></tr>
<tr><td>d) Monitor the progress made during implementation.</td><td>(*) - 2018+</td><td>GREPECAS</td><td>Valid</td></tr>
<tr><td>Relation-ship with GPIs</td><td colspan="4">GPI/1: Flexible use of airspace, GPI/5: performance-based navigation, GPI/8: collaborative airspace design and management, GPI/12: functional integration of ground and airborne systems and GPI/14; runway operations.</td></tr>
</table>

(*) Indicates that the task has been started before the period contemplated in this planning.

REGIONAL PERFORMANCE OBJECTIVE: <u>SAM ATM/04</u> FLEXIBLE USE OF AIRSPACE	
Benefits	
Safety	• Improvement of coordination and civil/military cooperation strengthens airspace safety.
Environmental protection and sustainable development of air transport	• Permits a more efficient ATS route structure, by reducing miles flown, fuel consumption and, consequently, CO^2 emissions into the atmosphere. • Increases airspace capacity. • Greater availability of reserved airspace aviation at times when there is no activity from those airspace users

Metrics

- Percentage of committees or similar civil/military coordination bodies implemented
- Number of civil/military coordination and cooperation agreements implemented
- Permanent reduction of reserved airspaces

2012 - 2018
Strategy

ATM OC COMPONENTS	TASKS	PERIOD	RESPONSIBILITY	STATUS
AOM **AUO** **CM**	a) Develop guidance material on civil/military coordination and cooperation, for the definition of policies, procedures and national standards;	(*) - 2012	Regional Project States	Valid
	b) Carry out an assessment of the amount and extension of reserved airspaces	(*) - 2012	States	Valid
	c) Establish committees or similar civil/military coordination bodies;	(*) - 2012	States	Valid
	d) Make arrangements to have a permanent relationship and close cooperation between ATS civil units and the appropriate military units, as well as other reserved airspace users;	(*) - 2012	States	Valid
	e) Establish procedures for coordination of temporary reservation of airspace (TRA) through issuance of NOTAMs or specific real time reserved airspace activation procedures, when so required for ANSPs.	(*) - 2013	States	Valid
	f) Develop a regional strategy and work programme for the implementation of the flexible use of airspace, through a phased approach, starting with a more dynamic sharing of reserved airspace, taking UAS into consideration.	2012 - 2018	Regional Project States	Valid
	g) Monitor progress during implementation.	(*) - 2013	GREPECAS	Valid
Relation-ship with GPIs	GPI/1: Flexible use of airspace; GPI/18: Aeronautical information.			

(*) Indicates that the task has been started before the date contemplated in this planning.

REGIONAL PERFORMANCE OBJECTIVE: SAM ATM/05 ATFM IMPLEMENTATION	
Benefits	
Safety	• Avoids ATC and airport system overload, by reinforcing safety
Environmental protection and sustainable development of air transport	• Less delays caused by meteorological and traffic conditions, leading to a reduced consumption of fuel and emission of pollutants • Improved prediction • Improved management of the demand that exceeds service in ATC sectors and aerodromes
Metrics	
• Percentage of flights delayed due to measures implemented by ATC	
2012 - 2018 Strategy	

ATM OC COMPONENTS	TASKS	PERIOD	RESPONSIBILITY	STATUS
DCB AO AOM CM	a) Assess the progress made in the ATFM implementation work programme	2012	States	Valid
	b) Assess meteorological information requirements for ATFM implementation purposes.	2012	States	Valid
	c) Develop a regional method for establishing demand/capacity forecasts	(*) - 2013	States	Valid
	d) Develop and implement regional procedures for an efficient and optimum use of aerodrome and runway capacity	(*) - 2014	States	Valid
	e) Develop and implement methods for improving efficiency, as required, through airspace management.	(*) - 2015	States	Valid
	f) Develop and implement operational coordination procedures between States ATFM units;	2012 – 2018+	States	Valid
	g) Monitor progress during implementation.	(*) – 2018+	GREPECAS	Valid
Relation-ship with GPIs	GPI/1: Flexible use of airspace; GPI/6: air traffic flow management; GPI/7: dynamic and flexible management of ATS routes; GPI/9: situational awareness; GPI/13 aerodrome design and management; GPI/14: runway operations; and GPI/16: decision support and alerting systems.			

(*) Indicates that the task has been started before the date contemplated in this planning.

REGIONAL PERFORMANCE OBJECTIVE: <u>SAM ATM/06</u> **IMPROVE ATM SITUATIONAL AWARENESS**				
Benefits				
Safety	• The availability of terrain and obstacle electronic date in the pilot post permits a reduces number of CFIT accidents • Improved situational awareness provides data that facilitate operational decision-making, enhancing safety.			
Environmental protection and sustainable development of air transport	• Improved air traffic demand provides a reduction in aircraft separation, enabling a best air traffic flow management and ATC capacity. • Contributes to collaboration between the flight crew and the ATM system • Contributes to collaborative decision-making (CDM) through the sharing of aeronautical data • Reduced workload for pilots and controllers			
Metrics				
• Reduction of CFIT accidents • Reduction of operational errors including LHDs				
2012 - 2018 ***Strategy***				
ATM OC COMPONENTS	**TASKS**	**PERIOD**	**RESPONSIBILITY**	**STATUS**
ATM-SDM **AO** **CM**	a) Develop an action plan for improving situational awareness of pilots and controllers.	(*) - 2012	Regional Project	Valid
	b) Implement flight plan data processing systems (new FPL format) and data communication tools between ACCs.	(*) – 2014	States	Valid
	c) Implement ATS surveillance technologies and their applications as required.	2012 – 2018+	States	Valid
	d) Implement air-ground communication systems through Data link (ADS-C/CPDLC in oceanic airspaces ADS-B, D-ATIS, DCL, D-VOLMET, etc.	(*) – 2018+	States	Valid
	e) Implement advanced automation support tools to contribute to aeronautical information sharing.	2015 – 2018+	States	Valid
	f) Monitor the implementation	(*) – 2018+	GREPECAS	Valid
Relation-ship with GPIs	GPI/1: Flexible use of airspace; GPI/6: air traffic flow management; and GPI/7: dynamic and flexible ATS route management; GPI/9: situational awareness; GPI/13: aerodrome design and management; GPI/14: runway operations; y GPI/16: decision support and alerting systems; GPI/17: implementation of Data link applications; GPI/18: aeronautical information; GPI/19: meteorological systems, GPI/22: communication infrastructure.			

(*) Indicates that the task has been started before the date contemplated in this planning.

REGIONAL PERFORMANCE OBJECTIVE: SAM ATM/07 FLIGHT PLAN IMPLEMENTATION				
Benefits				
Safety	• Incorporation of additional information in FPL reinforces safety.			
Environmental protection and sustainable development of air transport	• Expanded airspace capacity; • Enhanced operational efficiency.			
Metrics				
• Percentage of States that have implemented the new FPL.				
2012 - 2018 ***Strategy***				
ATM OC COMPONENTS	**TASKS**	**PERIOD**	**RESPONSIBILITY**	**STATUS**
SDM ATM	a) Guides on the transition to the new format of the filed flight plan.	(*)	ICAO	Valid
	b) Develop a regional strategy for the transition to the new format of the filed flight plan.	(*)	ICAO	Valid
	c) Identification of stakeholders and possible impact of the implementation of the new format of the filed flight plan (FPL/RPL/CPL).	(*)	States	Valid
	d) Assessment of current/future flight plan processing capabilities with respect to the new flight plan format.	(*)	States	Valid
	e) Behaviour trials between systems capable of processing the NEW flight plan.	(*)	States	Valid
	f) Development of contingency procedures and determination of technical/operational considerations for the transition.	(*)	States	Valid
	g) Identification of the main parties involved in FP data flow and the definition of the transition steps based on: - Systems capable of processing both formats: current and NEW. - Systems to be modernised / implemented before 2012 and that will be capable of processing the new format of the filed flight plan.	(*)	States	Valid
	h) Publication of transition actions, trials and other publications for users and interested parties	(*)	GREPECAS	Valid
	i) Assess transition actions and make adjustments.	(*)	States	Valid
	j) Implement the transition plan.	(*)	States	Valid
	k) Monitor transition activities.	(*)	ICAO	Valid
Relation-ship with GPIs	GPI/4: alignment of upper airspace classifications; GPI/1: flexible use of airspace; GPI/6 air traffic flow management; GPI/7: dynamic and flexible ATS route management; GPI/9: situational awareness; GPI/13: aerodrome management and design; GPI/14: runway operations; GPI/16: decision support and alerting systems; GPI/17: implementation of Data link applications; GPI/18: aeronautical information; GPI/19: meteorological systems; GPI/21: navigation systems; GPI/22: communication infrastructure			

NOTE: This PFF is based on the format presented to the CNS/ATM/SG/1 in March 2010. This Subgroup is responsible for the development of tasks.
(*) Indicates that the task has been started before the date contemplated in this planning.

<table>
<tr><td colspan="5">REGIONAL PERFORMANCE OBJECTIVE: <u>SAM CNS/01</u>
IMPROVEMENTS TO THE AERONAUTICAL FIXED SERVICE IN THE SAM REGION</td></tr>
<tr><td colspan="5">Benefits</td></tr>
<tr><td>Safety</td><td colspan="4">• Reduction of operational coordination errors between adjacent ACCs;
• Increased ATM situational awareness; and
• Reduced pilot and controller workload.</td></tr>
<tr><td>Environmental protection and sustainable development of air transport</td><td colspan="4">• Increased capacity and availability of aeronautical fixed service in support of ATS, MET, AIS and SAR applications; and
• Support to ATFM / CDM.</td></tr>
<tr><td colspan="5">Metrics</td></tr>
<tr><td colspan="5">• Number of AMHS interconnection as per FASID Table 1Bb;
• Number of AIDC interconnections as per FASID Table 1Bb; and
• Percentage of phases completed for the implementation of the new regional network.</td></tr>
<tr><td colspan="5">2012 – 2018
Strategy</td></tr>
<tr><td>ATM OC COMPONENTS</td><td>TASKS</td><td>PERIOD</td><td>RESPONSIBILITY</td><td>STATUS</td></tr>
<tr><td rowspan="7">AOM
ATM-SDM
DCB
CM
AUO</td><td>a) Complete the implementation of AMHS systems in those States that do not have such systems yet</td><td>(*) - 2013</td><td>States</td><td>Valid</td></tr>
<tr><td>b) AMHS interconnection between adjacent States</td><td>(*) - 2014</td><td>States</td><td>Valid</td></tr>
<tr><td>c) Implement communication services for the centralised ATFM</td><td>2015 - 2018+</td><td>States</td><td>Valid</td></tr>
<tr><td>d) Implement AIDC in the automated centres of the SAM Region</td><td>(*) - 2013</td><td>States</td><td>Valid</td></tr>
<tr><td>e) Operational implementation of AIDC between adjacent ACCs</td><td>(*) - 2014</td><td>States</td><td>Valid</td></tr>
<tr><td>f) Implementation of new digital network (REDDIG II)</td><td>2012 -2015</td><td>States</td><td>Valid</td></tr>
<tr><td>g) Monitor implementation progress</td><td>2012-2017</td><td>GREPECAS</td><td>Valid</td></tr>
<tr><td>Relation-ship with GPIs</td><td colspan="4">GPI/6: ATFM, GPI/9: situational awareness, GPI/ 16: decision support and alerting systems, GPI/18: aeronautical information, GPI/17: data link applications, GPI/19: meteorological systems, GPI/22: communication infrastructure.</td></tr>
</table>

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REGIONAL PERFORMANCE OBJECTIVE: <u>SAM CNS/02</u>
IMPROVEMENTS TO THE AERONAUTICAL MOBILE SERVICES IN THE SAM REGION

Benefits

Safety	• Reduction of operational coordination errors between adjacent ACCs, making ATS coordination more efficient; and • Reduction of pilot and controller workload.
Environmental protection and sustainable development of air transport	• Assured coverage and quality of communications in ATS service; • Increased availability of communications for the ATS service; • Support to AIM/MET service; and • Assured radio frequency spectrum assigned to aviation for the communication service.

Metrics

- Percentage of compliance with FASID Table 2-A;
- Number of CPDLC systems implemented;
- Number of DCL systems implemented;
- Number of D-ATIS systems implemented, and
- Number of VOLMET systems implemented.

2012 - 2018
Strategy

ATM OC COMPONENTS	TASKS	PERIOD	RESPONSIBILITY	STATUS
AOM ATM-SDM DCB CM	a) Complete the implementation of the services required in Table CNS 2-A “Aeronautical Mobile Service - AMSS”	(*) - 2014	States	Valid
	b) Continental en-route: Complete coverage of VHF communications in the lower airspace, when operations so require	2012- 2015	States	Valid
	c) Implement oceanic area CPDLC, maintaining HF service as back-up	(*) - 2018	States	Valid
	d) Implement CPDLC in selected continental area	2012- 2018	States	Valid
	e) Terminal area: Implementation of different VHF channels for control tower and APP services at all airports where a single channel is used for APP and control tower services	(*) - 2015	States	Valid
	f) Implementation of DCL services at selected aerodromes	2016-2018	States	Valid
	g) Implementation of D-ATIS services at selected aerodromes.	2012-2017	States	Valid
	h) Implementation of VOLMET services (voice and data)	(*) - 2018	States	Valid
	i) Guarantee protection of the radio frequency spectrum used for current and foreseen communication services	(*) - 2018	States ICAO	Valid
	j) Monitor implementation progress	2012-2018	GREPECAS	Valid
Relation-ship with GPIs	GPI/6: ATFM, GPI/9: Situational awareness, GPI/17: Data link applications, GPI/19: Meteorological systems, GPI/22: Communication infrastructure, GPI 23: Aeronautical radio spectrum.			

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<table>
<tr><th colspan="5">REGIONAL PERFORMANCE OBJECTIVE: <u>SAM CNS/03</u>
IMPROVEMENTS TO NAVIGATION SYSTEMS IN THE SAM REGION</th></tr>
<tr><th colspan="5">Benefits</th></tr>
<tr><td>Safety</td><td colspan="4">• Support to aircraft spacing;
• Reduced pilot and controller workload; and
• Increased landing safety, avoiding CFIT</td></tr>
<tr><td>Environmental protection and sustainable development of air transport</td><td colspan="4">• Increased airspace capacity and structure;
• Increased integrity of the GNSS system;
• Support to PBN implementation; and
• Reduced costs.</td></tr>
<tr><th colspan="5">Metrics</th></tr>
<tr><td colspan="5">• Number of deactivated NDBs in accordance with FASID Table 3-3; and
• Number of GBAS implemented at airports with sufficient operational demand.</td></tr>
<tr><th colspan="5">2012 - 2018
Strategy</th></tr>
<tr><th>ATM OC COMPONENTS</th><th>TASKS</th><th>PERIOD</th><th>RESPONSIBILITY</th><th>STATUS</th></tr>
<tr><td rowspan="6">AOM
ATM-SDM
TS
AUO</td><td>a) Continue with NDB phase-out</td><td>*- 2018+</td><td>States</td><td>Valid</td></tr>
<tr><td>b) Implement new DME systems in support of en route operations where the PBN plan so considers it</td><td>2012-2018</td><td>States
ICAO</td><td>Valid</td></tr>
<tr><td>c) Implement GBAS at airports with sufficient operational demand</td><td>2015-2018+</td><td>States</td><td>Valid</td></tr>
<tr><td>d) Modernisation of flight trial platforms for GNSS applications</td><td>2012-2017</td><td>States</td><td>Valid</td></tr>
<tr><td>e) Guarantee the protection of the radio frequency spectrum used for current and future radio navigation services</td><td>(*)-2018</td><td>States
ICAO</td><td>Valid</td></tr>
<tr><td>f) Monitor implementation progress</td><td>2012-2018</td><td>GREPECAS</td><td>Valid</td></tr>
<tr><td>Relation-ship with GPIs</td><td colspan="4">GPI/5: RNAV and RNP; GPI/6: ATFM; GPI/7: dynamic and flexible ATS route management; GPI/10: terminal area design and management; GPI/11: RNP and RNAV SIDs and STARs; GPI/12: functional integration of ground and airborne systems; GPI/13: aerodrome design and management; GPI/14: runway operations; GPI/21: navigation systems; GPI 23: aeronautical radio spectrum.</td></tr>
</table>

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<table>
<tr><td colspan="5">REGIONAL PERFORMANCE OBJECTIVE: <u>SAM CNS/04</u>
IMPROVEMENTS TO THE ATS SURVEILLANCE SERVICE IN THE SAM REGION</td></tr>
<tr><td colspan="5">Benefits</td></tr>
<tr><td>Safety</td><td colspan="4">• Increased ATM situational awareness;
• Improved ATS coordination, reducing coordination errors between adjacent ACCs; and
• Reduction of pilot and controller workload.</td></tr>
<tr><td>Environmental protection and sustainable development of air transport</td><td colspan="4">• Facilitates ATS planning;
• Increased airspace capacity;
• Supports the implementation of PBN and random routes; and
• Optimisation of information sharing resources.</td></tr>
<tr><td colspan="5">Metrics</td></tr>
<tr><td colspan="5">• Number of ADS-C systems implemented in oceanic FIRs;
• Number of adjacent ACCs with exchange of ATS surveillance data,
• Percentage of ensure airspace for upper levels with ADS-B coverage, and
• Number of A-SMGS systems implemented.</td></tr>
<tr><td colspan="5">2012 – 2018
Strategy</td></tr>
<tr><td>ATM OC COMPONENTS</td><td>TASKS</td><td>PERIOD</td><td>RESPONSIBILITY</td><td>STATUS</td></tr>
<tr><td rowspan="6">AOM
AO
TS
CM
ATM-SDM</td><td>a) implement ADS-B and/or MLAT systems in en-route areas</td><td>2012-2018+</td><td>States</td><td>Valid</td></tr>
<tr><td>b) Implement surface movement guidance and control systems (A-SMGCS) at airports where previous study indicates its requirement</td><td>2013- 2018+</td><td>States</td><td>Valid</td></tr>
<tr><td>c) Implement the ADS-C service in all States with responsibility over an oceanic FIR</td><td>(*) - 2018</td><td>States</td><td>Valid</td></tr>
<tr><td>d) Implement the exchange of ATS surveillance data between adjacent ACCs</td><td>(*) - 2018+</td><td>States</td><td>Valid</td></tr>
<tr><td>e) Guarantee the protection of the radio frequency spectrum used for current and future radio navigation services</td><td>(*) - 2018</td><td>States
ICAO</td><td>Valid</td></tr>
<tr><td>f) Monitor implementation progress</td><td>2012-2018</td><td>GREPECAS</td><td>Valid</td></tr>
<tr><td>Relation-ship with GPIs</td><td colspan="4">GPI/5: RNAV and RNP; GPI/6: ATFM; GPI/9: situational awareness; GPI/10: terminal area design and management; GPI/11: RNP and RNAV SIDs and STARs with; GPI/12: functional integration of ground and on-board systems; GPI/13: aerodrome design and management; GPI/14: runway operations; GPI/17: data link applications, GPI/22: communication infrastructure, GPI 23: aeronautical radio spectrum.</td></tr>
</table>

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REGIONAL PERFORMANCE OBJECTIVE: <u>SAM MET/01</u> IMPLEMENTATION OF THE MET INFORMATION QUALITY MANAGEMENT SYSTEM				
Benefits				
Safety	• Ensure the quality of meteorological data and products provided to all the users of the ATM community • Improve the trust of the user with respect to meteorological data used for flight planning and re-planning.			
Metrics				
• Number of international aerodromes with implemented QMS/MET. • Number of international aerodromes with certified QMS/MET.				
2012 – 2018 ***Strategy***				
ATM OC COMPONENTS	**TASKS**	**PERIOD**	**RESPONSIBILITY**	**STATUS**
	a) Ensure the implementation of the MET information quality management system QMS/MET)	(*) 2012-2015	Regional Project States	Valid
	b) Develop the LAR-MET	2013-2015	Regional Project States	Valid
	c) Certify and maintain the certification of the QMS/MET quality management system by an approved organisation in all AOP aerodromes.	(*) 2015	States	Valid
	d) Monitor the process of QMS/MET implementation	2012-2018	GREPECAS	Valid
Relationship with GPIs	GPI/18: Aeronautical information and GPI/19: Meteorological systems.			

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REGIONAL PERFORMANCE OBJECTIVE: SAM MET/02
IMPROVEMENTS IN MET FACILITIES

Benefits

Safety	• Provide more reliable MET information to all the ATM community. • Assistance in decision-making for ATM. • Assurance of availability of MET information for the user • Contribute to situational awareness of aeronautical users for all weather operations (AWO).

Metrics

- Number of international aerodromes with operative AWOS.
- Number of MWOs with the required equipment and systems.
- Number of AOP aerodromes with updated summaries and climatological tables.

2012 - 2018
Strategy

ATM OC COMPONENTS	TASKS	PERIOD	RESPONSIBILITY	STATUS
AOM **DCB** **AO** **AUO** **ATM-SDM** **CM**	a) Establish a regional plan for the automation of meteorological data at all AOP aerodromes. b) Establish a regional plan to strengthen Meteorological Watch Offices (MWOs) with the infrastructure required for the effective watch in the FIRs.	2012-2018	Regional Project States	Valid
	c) Establish programmes for periodic inspection and calibration of meteorological instruments of EMA(s)	2012-2014	States	Valid
	d) Develop and implement a programme for the update of the summaries and climatological tables of AOP aerodromes.	2012-2014	States	Valid
	e) Monitor the implementation of the different programmes	2012-2014	GREPECAS States	Valid
Relationship with GPIs	GPI/9: Situational awareness, GPI/14: Runway operations, GPI/18: Aeronautical information and GPI/19: Meteorological systems.			

REGIONAL PERFORMANCE OBJECTIVE: SAM MET/03

IMPROVEMENTS IN THE IMPLEMENTATION OF INTERNATIONAL AIRWAYS VOLCANO WATCH (IAVW), SURVILLANCE OF THE ACCIDENTAL RELEASE OF RADIOACTIVE MATERIAL AND THE ISSUANCE OF SIGMETs

Benefits

Safety	• Increased flight safety with the provision of information on volcanic ash and severe phenomena
Environmental protection and sustainable	• Support pre-flight planning, optimising air routes with respect to volcanic ash and the accidental release of radioactive material. • Support the planning of new air routes in a safe and sustainable manner.

Metrics

- Number of States with IAVW and their implemented evolutions.
- Number of States with contingency plan for volcanic ash and accidental release of radioactive material, approved.

2012 – 2018
Strategy

ATM OC COMPONENTS	TASKS	PERIOD	RESPONSIBILITY	STATUS
AOM **AO** **AUO** **ATMSDM** **DCB** **CM**	a) Develop a plan to ensure the implementation of improvements in the international airways volcano watch	(*) 2012	Regional Project	Valid
	b) Develop a Guide for IAVW implementation in the Region, based on ICAO Document 9766.	2012-2013	Regional Project States	Valid
	c) Update the letters of agreement between CAAs/MET/State vulcanologic bodies, describing the responsibilities of each institution (including VONA format)	(*) 2012	States	Valid
	d) Where applicable, develop written agreements with national meteorological services (NMS) in case of accidental release of radioactive material.	(*) 2012	States	Valid
	e) Update the letters of operational agreement between ATS/MET units,	(*) 2012	States	Valid
	f) Develop a regional contingency planfor cases of volcanic activity	2012-2013	Regional Project	Valid
	g) Develop a regional contingency plan for cases of accidental release of radioactive material.	2012-2013	Regional Project	Valid
	h) Update the procedures in MWOs and VAACs according to Amendments 76 and 77 of Annex 3	2013-2018	States	Valid
Relation-ship with GPIs	GPI/9: Situational awareness, GPI/14: Runway operations, GPI/16: Decision support and alerting systems, GPI/18: Aeronautical information and GPI/19: Meteorological systems.			

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REGIONAL PERFORMANCE OBJECTIVE: SAM MET/04 IMPROVEMENTS IN OPMET INFORMATION EXCHANGE AND FOLLOW-UP OF WAFS EVOLUTION	
Benefits	
Safety	• Timely provision of duly coded OPMET information to the ATM community • Increased regional use of meteorological forecasts (upper wind, turbulence, icing, convective clouds and others).
Environmental protection and development of air transport	• Increased efficiency of operations and reduced carbon emissions
Metrics	
• Increased availability of OPMET information (in percentage) at regional and international level. • Number of States that have implemented WAFS and its evolutions.	
2012 - 2018 ***Strategy***	

ATM OC COMPONENTS	TASKS	PERIOD	RESPONSIBILITY	STATUS
AOM **DCB** **AO** **AUO** **ATMSDM** **CM**	a) Establish a regional procedure to ensure timely availability of duly coded OPMET information	(*) 2018	States / Brasilia OPMET database	Valid
	b) Develop contingency procedures for the dissemination of OPMET information through the Internet in case of communication system failure.	2012 - 2013	States	Valid
	c) Implement the new turbulence, icing, and convective cloud forecasts	(*) 2013	States	Valid
	d) Develop and implement a transition plan for OPMET information coding in XML format	2013-2018	Regional Project States	Valid
	e) Establish plans for the migration from ISCS to WIFS.	(*) 2014	States	Valid
	f) Develop, together with COM units, a migration plan that permits WAFS products to be compatible with the future NextGEN/SESAR environment.	2013-2018+	Regional Project	Valid
	g) Develop and implement regional procedures in support of ATM.	(*) 2018+	ICAO States	Valid
Relation-ship with GPIs	GPI/9: Situational awareness, GPI/14: Runway operations, GPI/18: Aeronautical information and GPI/19: Meteorological systems.			

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<table>
<tr><td colspan="5">REGIONAL PERFORMANCE OBJECTIVE: <u>SAM SAR/01</u>
COOPERATION AND COORDINATION OF SAR SERVICES AT REGIONAL LEVEL</td></tr>
<tr><td colspan="5">Benefits</td></tr>
<tr><td>Safety</td><td colspan="4">• Favours the application of practical risk management principles</td></tr>
<tr><td>Environmental protection and development of air transport</td><td colspan="4">• Ensure cooperation and coordination amongst the interested parties</td></tr>
<tr><td colspan="5">Metrics</td></tr>
<tr><td colspan="5">• Number of letters of agreement established for SAR
• Number of SAR exercises conducted</td></tr>
<tr><td colspan="5">2012 - 2018
Strategy</td></tr>
<tr><td>ATM OC COMPONENTS</td><td>TASKS</td><td>PERIOD</td><td>RESPONSIBILITY</td><td>STATUS</td></tr>
<tr><td rowspan="7">N/A</td><td>a) Assess SAR requirements at regional level</td><td>2011</td><td>ICAO-States</td><td>Valid</td></tr>
<tr><td>b) Adopt SAR requirements at regional level</td><td>2012 - 2014</td><td>States</td><td>Valid</td></tr>
<tr><td>c) Comply with risk and quality management practical principles</td><td>(*) - 2017</td><td>States</td><td>Valid</td></tr>
<tr><td>d) Develop, update, establish and ratify SAR agreements between States</td><td>(*) - 2017</td><td>States</td><td>Valid</td></tr>
<tr><td>e) Harmonise SAR training plans</td><td>(*) - 2013</td><td>CATC</td><td>Valid</td></tr>
<tr><td>f) Conduct annual SAR exercises at regional level</td><td>(*) - 2015</td><td>States</td><td>Valid</td></tr>
<tr><td>g) Monitor implementation progress</td><td>2012 - 2018</td><td>GREPECAS</td><td>Valid</td></tr>
<tr><td>Relation-ship with GPIs</td><td colspan="4">Not applicable</td></tr>
</table>

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REGIONAL PERFORMANCE OBJECTIVE: SAM AIM/01 IMPROVEMENT OF QUALITY, INTEGRITY AND AVAILABILITY OF AERONAUTICAL INFORMATION	
Benefits	
Safety	• Assures data integrity and resolution • Favours information traceability
Environmental protection and development of air transport	• Assures timely awareness of significant changes in information

Metrics

- Number of States that meet the AIRAC calendar
- Number of States that have implemented QMS
- Number of corrected deficiencies
- Number of States establish SLA agreements
- Number of States that completed WGS84 implementation

2012 - 2018
Strategy

ATM OC COMPONENTS	TASKS	PERIOD	RESPONSIBILITY	STATUS
AOM **AO** **DCB** **AUO**	a) Action plan to resolve AIS deficiencies.	(*) 2012	States	Valid
	b) Assess the status of implementation and update of the AIM Action Plan	2012	Regional Project	Valid
	c) Effective compliance with the AIRAC system	(*) - 2012	States	Valid
	d) Establish a quality management system (QMS)	(*) - 2013	States	Valid
	e) Complete the use of WGS-84, taking into account the new data products	(*) - 2013	States	Valid
	f) Develop guidelines on service level agreements (SLAs) between data originators and AIM	* - 2012	Regional Project	Valid
	g) Establish agreements with data originators (SLAs)	2012 - 2013	States	Valid
	h) Monitor the implementation of the AIM Action Plan	2012 - 2018	GREPECAS	Valid
Relation-ship with GPIs	GPI/9: Situational awareness, GPI/16: Decision support and alerting systems, GPI/18: Aeronautical information, GPI/20: WGS-84, GPI/21: Navigation systems.			

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REGIONAL PERFORMANCE OBJECTIVE: SAM AIM/02 **TRANSITION TO THE PROVISION OF ELECTRONIC AERONAUTICAL INFORMATION**				
Benefits				
Safety	• Support to ground proximity warning systems (GPWS) and procedure design and optimisation tools.			
Environmental protection and development of air transport	• Integration of dynamic and static information into a single display to facilitate situational awareness. • Access to information during all flight phases.			
Metrics				
• Number of States that have implemented the transition plan				
2012 - 2018 ***Strategy***				
ATM OC COMPONENTS	**TASKS**	**PERIOD**	**RESPONSIBILITY**	**STATUS**
AOM **AO** **CM** **DCB** **TS** **AUO** **ATM-SDM**	a) Prepare a transition plan for the provision of electronic aeronautical information	2012	Regional Project	Valid
	b) Implement the transition plan for the provision of electronic aeronautical information	2013 - 2018+	States	Valid
	c) Develop and establish a programme to facilitate AIS - MET interoperability	2016 - 2018	Regional Project	Valid
	d) Prepare an Action Plan for implementation of a GIS	(*) 2012	Regional Project	Valid
	e) Monitor the implementation of the transition plan for the provision of electronic aeronautical information	2012 - 2018+	GREPECAS	Valid
Relationship with GPIs	GPI/9: Situational awareness, GPI/16: Decision support and alerting systems, GPI/18: Aeronautical information, GPI/19: Meteorological systems, GPI/20: WGS-84.			

<table>
<tr><td colspan="5">REGIONAL PERFORMANCE OBJECTIVE: <u>SAM AGA/01</u>
QUALITY AND AVAILABILITY OF AERONAUTICAL DATA</td></tr>
<tr><td colspan="5">Benefits</td></tr>
<tr><td>Safety</td><td colspan="4">• Less aircraft accidents at the aerodrome;
• Improved aircraft safety at the aerodrome;</td></tr>
<tr><td>Environmental protection and development of air transport</td><td colspan="4">• Efficient aerodrome operations based on aeronautical data quality assurance.</td></tr>
<tr><td colspan="5">Metrics</td></tr>
<tr><td colspan="5">• Number of deficiencies related to non-compliance of the information contained in FASID Table AOP 1. Doc. 8733, Vol. II
• Number of aerodromes with processes defined and implemented with AIM</td></tr>
<tr><td colspan="5">2012 - 2018
Strategy</td></tr>
<tr><td>ATM OC COMPONENTS</td><td>TASKS</td><td>PERIOD</td><td>RESPONSIBILITY</td><td>STATUS</td></tr>
<tr><td rowspan="3">AO
CM
AUO</td><td>a) Develop a regional action plan to update the information contained in Document 8733 CAR/SAM Navigation Plan, Vol. II FASID, Table AOP1</td><td>(*) - 2018</td><td>Regional Project/ GREPECAS</td><td>Valid</td></tr>
<tr><td>b) Establish and implement a process to assure the provision of aeronautical data to AIM by the airport operator with the corresponding quality requirements.</td><td>(*) - 2018</td><td>Regional Project/States</td><td>Valid</td></tr>
<tr><td>c) Update aerodrome obstacle data in the WGS-84.</td><td>(*) – 2018+</td><td>Regional Project/ GREPECAS</td><td>Valid</td></tr>
<tr><td>Relationship with GPIs</td><td colspan="4">GPI/9: situational awareness, GPI/10: terminal area design and management, GPI/13: aerodrome design and management; GPI/14: runway operations, GPI/18: aeronautical information, GPI/20: WGS-84.</td></tr>
</table>

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REGIONAL PERFORMANCE OBJECTIVE: SAM AGA/02 **AERODROME CERTIFICATION**				
Benefits				
Safety	• Less aircraft accidents at the aerodrome;			
Environmental protection and development of air transport	• Efficient aerodrome operations based on compliance with the SARPs;			
Metrics				
• Number of certified aerodromes • Number of trained inspectors • Number of aerodromes with a certification validated under LAR AGA.				
2012 - 2018 ***Strategy***				
ATM OC COMPONENTS	**TASKS**	**PERIOD**	**RESPONSIBILITY**	**STATUS**
AO **CM** **AUO** **DCB**	a) Harmonise national regulations of States with LAR-AGA	2012 – 2015	States	Valid
	b) Train regional aerodrome inspectors with the MIAGA	(*) – 2015	Regional Project	Valid
	c) Train regional aerodrome inspectors in auditing techniques	2014 - 2015	Regional Project	Valid
	d) Conduct multinational audit (certification) trials in the aerodromes of the Region	2014 – 2015	Regional Project/States	Valid
	e) Certification of aerodromes on the basis of LAR-AGA	(*) - 2018	States	Valid
	f) Validate aerodrome certificates granted before harmonization with LAR AGA	2015 – 2018+	States	Valid
	g) Surveillance of the certification process	2012 – 2018+	GREPECAS	Valid
Relationship with GPIs	GPI/9: situational awareness, GPI/10: terminal area design and management, GPI/13: aerodrome design and management. GPI/14: Runway operations.			

(*) Indicates that the task has been started before the date contemplated in this planning.

REGIONAL PERFORMANCE OBJECTIVE: SAM AGA/03 **SAFE OPERATIONS AT AERODROMES THAT DO NOT MEET ICAO SARPS**				
Benefits				
Safety	• Dispose of tools for the evaluation of deviations • Reduce aircraft incidents in aerodrome			
Environmental protection and development of air transport	• Efficient aerodrome operations			
Metrics				
• Number of certified aerodromes				
2012 - 2018 ***Strategy***				
ATM OC COMPONENTS	**TASKS**	**PERIOD**	**RESPONSIBILITY**	**STATUS**
AO **CM** **AUO**	a) Identify the regional airports with physical and operational characteristics that do not comply with ICAO SARPs.	(*) – 2014	Regional Project	Valid
	b) Develop a procedure for certification with deviation, including orientations for the evaluation of the non-conformities.	(*) - 2014	Regional Project	Valid
	c) Implement the procedure for certification with deviations.	2013 - 2018	States	Valid
	d) Surveillance of certification process.	2012 - 2018	GREPECAS	Valid
Relationship with GPIs	GPI/9: situational awareness, GPI/13: aerodrome design and management. GPI/14: runway operations.			

(*) Indicates that the task has been started before the date contemplated in this planning.

REGIONAL PERFORMANCE OBJECTIVE: SAM AGA/04 IMPROVEMENT OF AERODROME PHYSICAL AND OPERATIONAL CHARACTERISTICS				
Benefits				
Safety	• Increases safe aircraft operations.			
Environmental protection and development of air transport	• Guides and operational criteria that increase capacity with efficiency; • Traffic fluidity in the movement areas.			
Metrics				
• Number of aerodromes in which capacity has been optimised. • Number of aerodromes with increased capacity due to infrastructure improvement				
2012 - 2018 ***Strategy***				
ATM OC COMPONENTS	**TASKS**	**PERIOD**	**RESPONSIBILITY**	**STATUS**
	a) Develop procedures for the calculation of aerodromes capacity	(*) - 2014	Regional Project	Valid
	b) Train instructors to replicate procedures for calculation of capacity	(*) - 2014	Regional Project	Valid
AO **CM** **AUO**	c) Implement procedures for calculation of capacity and assess the aerodromes whose installed capacity is near saturation.	(*) - 2014	States	Valid
	d) Develop procedures to optimise aerodrome runway and apron capacity	(*) - 2013	Regional Project	Valid
	e) Apply procedures for optimising aerodrome runway and apron capacity	2013 - 2018	States	Valid
	f) Develop environmental management procedures in coordination with the Regional Committees	(*) - 2018	Proyecto Regional	Valid
	g) Establish, in coordination with CNS, requirements to be applied to aerodromes operations for the implementation of surface movement guide and control systems	(*) - 2018	Regional Project	Valid
	h) Surveilance of runway and apron capacity optimisation	(*) - 2018	GREPECAS	Valid
Relationship with GPIs	GPI/9: situational awareness; GPI/13: aerodrome design and management; GPI/14: Runway operations.			

(*) Indicates that the task has been started before the date contemplated in this planning.

<table>
<tr><td colspan="5">REGIONAL PERFORMANCE OBJECTIVE: <u>SAM HR/01</u>
Planning of training for development of personnel competence in air navigation system</td></tr>
<tr><td colspan="5">Benefits</td></tr>
<tr><td>Safety</td><td colspan="4">• Reinforces safety</td></tr>
<tr><td>Environmental protection and sustainable development of air transport</td><td colspan="4">• Information available with a level of quality that is appropriate to the requirements.
• Personnel duly trained as instructors in the ATM operational concept.
• Personnel duly trained to manage, operate and maintain the air navigation system..
• Increases situational awareness of the personnel.
• Provides for quality air navigation services.</td></tr>
<tr><td colspan="5">Metrics</td></tr>
<tr><td colspan="5">• Number of States that meet the training requirements in the ATM Operational Concept.
• Number of CATCs certified by ICAO or by States</td></tr>
<tr><td colspan="5">2012 - 2018
Strategy</td></tr>
<tr><td>ATM OC COMPONENTS</td><td>TASKS</td><td>PERIOD</td><td>RESPONSIBILITY</td><td>STATUS</td></tr>
<tr><td rowspan="8">AOM,
AO
AUO
DCB ATM-SDM
CM
TS</td><td>a) Develop the training programme for air navigation service personnel to respond to the new challenges, taking into account ICAO documentation.</td><td>2012-2013</td><td>Regional Project</td><td>Valid</td></tr>
<tr><td>b) Follow up the activities of the New Generation of Aviation Professionals (NGAP) Special Team and implement the results in the region.</td><td>201-12 - 2016</td><td>States</td><td>Valid</td></tr>
<tr><td>c) Establish a group of trainers in the ATM Operational Concepts to train instructors in the SAM Region</td><td>2012-2013</td><td>Regional Project</td><td>Valid</td></tr>
<tr><td>d) Prepare guides for training, planning and the ATM Operational Concept.</td><td>2013-2014</td><td>Regional Project</td><td>Valid</td></tr>
<tr><td>e) Prepare a programme for instructors on training, planning and the ATM Operational Concept.</td><td>2013-2014</td><td>Regional Project</td><td>Valid</td></tr>
<tr><td>f) Strengthen Civil Aviation Training Centres (CATCs) of the Region through certification, evaluation and follow up</td><td>2012 – 2014</td><td>Regional Project
States</td><td>Valid</td></tr>
<tr><td>g) Conduct courses on training, planning and the ATM Operational Concept</td><td>2013-2016</td><td>States</td><td>Valid</td></tr>
<tr><td>h) Monitor the training and updating of air navigation personnel</td><td>2016-2018+</td><td>GREPECAS
States</td><td>Valid</td></tr>
<tr><td>Relation-ship with GPIs</td><td colspan="4">The updating and training of aeronautical personnel is a cross-cutting issue for all ATM system areas.</td></tr>
</table>

<table>
<tr><td colspan="5">REGIONAL PERFORMANCE OBJECTIVE: <u>SAM SM/01</u>
SAFETY</td></tr>
<tr><td colspan="5">Benefits</td></tr>
<tr><td>Safety</td><td colspan="4">• Strengthens safety</td></tr>
<tr><td colspan="5">Metrics</td></tr>
<tr><td colspan="5">• N° of EI for ANS and AGA
• Number of States that have implemented SSPs
• Number of international airports that have implemented SMS
• Number of ATS services that have implemented SMS.</td></tr>
<tr><td colspan="5">2012 - 2018
Strategy</td></tr>
<tr><td>ATM OC COMPONENTS</td><td>TASKS</td><td>PERIOD</td><td>RESPONSIBILITY</td><td>STATUS</td></tr>
<tr><td rowspan="11">AOM
AUO</td><td>a) Development of associated standards and procedures to comply with safety surveillance requirements at the air navigation and aerodrome services</td><td>2013-2015</td><td>Regional Project</td><td>Valid</td></tr>
<tr><td>b) Assist in the strengthening of the civil aviation administrations, to comply with the air navigation and aerodrome services surveillance tasks</td><td>2014-2018</td><td>Regional Project</td><td>Valid</td></tr>
<tr><td>c) Follow up of the RASG-PA work programme, as a reference for the activities of the region.</td><td>(*) – 2018+</td><td>States</td><td>Valid</td></tr>
<tr><td>d) Prepare guidelines for the implementation of SMS in ATS services and international aerodromes.</td><td>(*) - 2012</td><td>Regional Project</td><td>Valid</td></tr>
<tr><td>e) Assist in the implementation of State safety programmes (SSPs).</td><td>2012</td><td>Regional Office</td><td>Valid</td></tr>
<tr><td>f) Develop regional safety databases</td><td>2012 - 2013</td><td>Regional Project</td><td>Valid</td></tr>
<tr><td>g) Formulate guidelines for the protection of safety data</td><td>2012 - 2014</td><td>Regional Project</td><td>Valid</td></tr>
<tr><td>h) Effective implementation of SMS in ATS and international airports.</td><td>(*) - 2014</td><td>States</td><td>Valid</td></tr>
<tr><td>i) Develop and implement a training plan concerning the development and application of a safety case</td><td>(*) - 2012</td><td>States</td><td>Valid</td></tr>
<tr><td>j) Assess and assist States in the effective implementation of actions, in order to improve safety.</td><td>(*) - 2018</td><td>GREPECAS</td><td>Valid</td></tr>
<tr><td>k) Continuous monitoring and periodical assessment of safety efficacy and SMS and SSP implementation</td><td>2012 - 2018</td><td>GREPECAS</td><td>Valid</td></tr>
<tr><td>Relation-ship with GPIs</td><td colspan="4">The systemic safety approach is holistic, applied to the whole ANS system.</td></tr>
</table>

(*) Indicates that the task has been started before the date contemplated in this planning.

RELATIONSHIP OF THE ACTIVITIES BETWEEN PFF(s)

AREA	ATM	AGA/AOP		AIM		CNS		MET	
ATM		ATM/2-AGA/AOP/1	c – c d – c	ATM/2-AIM/1	b – d, e c – d, e d – d, e e – d, e	ATM/1-CNS/2	b – a, c e – c, d f – a, b, c, d	ATM/1-MET/3	a – e, g
		ATM/3-AGA/AOP/1	a – a, b b – c c - c	ATM/2-AIM/2	b – a, b, d, e c – a, b, d, e d – a, b, d, e e – a, b, d, e	ATM/1-CNS/3	a – b f - b	ATM/1-MET/4	a – g
		ATM/3-AGA/AOP/4	b – a, b, c, d, e, f					ATM/2-MET/3	b – e, f, g c – e, f, g d - e, f, g e - e, f, g
		ATM/3-AGA/AOP/5	b – a, b					ATM/3-MET/3	b – e, f, g c – e, f, g
		ATM/5-AGA/AOP/4	c – a, b, c, d, e, f d - a, b, c, d, e, f	ATM/3-AIM/1	b – d, e c – d, e	ATM/1-CNS/4	b – c e – c f – a, c, d g – a, c, d	ATM/5-MET/1	b – a, c
						ATM/2-CNS/3	b – b	ATM/5-MET/2	b – a, b, c, d

AREA	**ATM**	**AGA/AOP**		**AIM**		**CNS**		**MET**	
							c - b		
						ATM/3 CNS/3	c - c	ATM/5-MET/3	b – a, c, d, e, g, h
						ATM/5-CNS/1	f -c	ATM/5-MET/4	b – a, b, c, g
						ATM/6-CNS/1	b – a, b, c, d, e d – c, d, f, g, h	ATM/7-MET/1	c – a d - a
				ATM/3-AIM/2	e – b	ATM/6-CNS/4	c – a, b, c, d d – a, c	ATM/7-MET/4	c – d d - d
				ATM/4-AIM/1	e – c, d, e				
				ATM/6-AIM/2	b – a, b, d, e c – a, b, d, e				
AGA/AOP				AGA/AOP/1-AIM/1	b – d g - e	AGA/AOP/4-CNS/4	g - b	AGA/AOP/5-MET/2	a - a
				AGA/AOP/1-AIM/2	b – d, e				
CNS				CNS/1-AIM/2	a – a, b f – a, b			CNS/2-MET/4	h – a, c. g

AREA	ATM		AGA/AOP		AIM		CNS		MET	
MET					MET/1-AIM/1	a - g				
					MET/3-AIM/2	f – c g – c				
					MET/1-AIM/2	a-g				
SAR	SAR/1-ATM/4	f - d								
RRHH	All the tasks of PFF/1		All the tasks of PFF/1		All the tasks of PFF/1		All the tasks of PFF/1		All the tasks o fPFF/1	
SM	All the tasks of PFF/1		All the tasks of PFF/1		All the tasks of PFF/1		All the tasks of PFF/1		All the tasks of PFF/1	

PFF RELATIONSHIP WITH ASBU BLOCK 0 MODULES SELECTED FOR THE SAM REGION
RELACIÓN DE LOS PFFCON LOS MÓDULOS DEL ASBU DEL BLOQUE 0 SELECCIONADO PARA LA REGIÓN SAM

ASBU / PFF	PIA1				PIA2			PIA3					PIA4		
	B015	**B0 65**	**B075**	**B0 80**	**B025**	**B030**	**B010**	**B035**	**B084**	**BO101**	**B0102**	**B0105**	**B005**	**B020**	**B040**
PFF SAM ATM/01							~~X~~								
PFFSAMATM/02													X	X	
PFFSAM ATM/03		~~X~~													
PFF SAM ATM/04							~~X~~								
PFF SAM ATM/05	~~X~~							~~X~~							
PFF SAM ATM/06			~~X~~						~~X~~		~~X~~				
PFF SAMATM/07 (I)*															
PFF SAM CNS/01					X			X				X			
PFFSAM CNS/02															X
PFF SAM CNS/03		~~X~~													
PFF SAM CNS/04			~~X~~						~~X~~		~~X~~				
PFFSAM MET/01												~~X~~			
PFF SAM MET/02			~~X~~									~~X~~			
PFF SAM MET/03				~~X~~								~~X~~			
PFF SAM MET/04				~~X~~								~~X~~			
PFFSAM SAR/01															
PFF SAM AIM/01						X									
PFF SAM AIM/02						X						~~X~~			
PFF SAM AGA/01						X									
PFF SAM AGA/02				~~X~~											
PFF SAM AGA/03				~~X~~											
PFF SAM AGA/04	~~X~~		~~X~~												
PFFSAM SAR701															
PFF SAM HHRR/01	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~
PFF SAM SM/01															

- I =Implantado

ATTACHMENT D

DESCRIPTION OF MODULES CONSIDERED FOR THE SAM REGION

PERFORMANCE IMPROVEMENT AREA 1: AIRPORT OPERATIONS

B0-15: Improve Traffic Flow through Runway Sequencing (AMAN/DMAN)

Introduction

This module introduces system capabilities to provide assistance for sequencing and metering to manage arrivals and departures (including time-based metering) to and from a multi-runway aerodrome or locations with multiple dependent runways at closely proximate aerodromes, to efficiently utilize the inherent runway capacity.

Baseline

Currently, sequencing is the manual process by which the air traffic controller uses local procedures and his expertise to sequence departures or arrivals in real time. This is generally leading to sub-optimal solutions both for the realized sequence and the flight efficiency, in particular in terms of taxi times and ground holding for departures, and in terms of holding for arrivals.

Change brought by the module

For departures, the sequence will allow improved start/push-back clearances, reducing the taxi time and ground holding, delivering more efficient departure sequences, reducing surface congestion and effectively and efficiently making use of terminal and aerodrome resources.

Departure management tools maximize the use of airspace capacity and assure full utilization of resources. They have the additional benefit of fuel efficient alternatives to reduce airborne and ground holding in an era in which fuel continues to be a major cost driver and emissions are a high priority. The use of these tools to assure facility of more efficient arrival and departure paths is a main driver in some modules of Block 0.

Necessary procedures (air and ground)

It is necessary to develop the systems and operational procedures for AMAN/DMAN. In particular, procedures for the extension of metering into en-route airspace will be necessary. RNAV/RNP for arrival will also be crucial as well.

Element 1: AMAN and time-based metering

Arrival management (AMAN) sequences the aircraft, based on the airspace state, wake turbulence, aircraft capability, and user preference. The established sequence provides the time that aircraft may have to lose before a reference approach fix, thereby allowing aircraft to fly more efficiently to the that fix and to reduce the use of holding stacks, in particular at low altitude. The smoothed sequence allows increased aerodrome throughput.

Time-based metering is the practice of separation by time rather than distance. Typically, the relevant ATC authorities will assign a time in which a flight must arrive at the aerodrome. This is known as the control time of arrival (CTA). CTAs are determined based on aerodrome capacity, terminal airspace capacity, aircraft capability, wind and other meteorological factors. Time-based metering is the primary mechanism in which arrival sequencing is achieved.

Element 2: Departure management

Departure management (DMAN), like its arrival counterpart, serves to optimize departure operation to ensure the most efficient utilization of aerodrome and terminal resources. Slots assignment and adjustments will be supported by departure management automations like departure management (DMAN) or departure flow management (DFM). Dynamic slot allocation will foster smoother integration into overhead streams and help the airspace users to better meet metering points and comply with other ATM decisions. Departure management sequences the aircraft, based on the airspace state, wake turbulence, aircraft capability, and user preference, to fit into the overhead en-route streams without disrupting the traffic flow. This will serve to increase aerodrome throughput and compliance with allotted departure time.

Intended performance operational improvement

In terms of Capacity improvements, time-based metering will optimize usage of terminal airspace and runway capacity. The utilization of terminal and runway resources will be optimized.

Efficiency is positively impacted as reflected by increased runway throughput and arrival rates. Efficiency is achieved through:

1) harmonized arriving traffic flow from en-route to terminal and aerodrome. Harmonization is achieved via the sequencing of arrival flights based on available terminal and runway resources; and
2) streamlined departure traffic flow and smooth transition into en-route airspace. Decreased lead time for departure request and time between call for release and departure time. Automated dissemination of departure information and clearances.

In terms of predictability it decreases uncertainties in aerodrome/terminal demand prediction and in terms of flexibility it enables dynamic scheduling.

Just as a reference to take into account, a detailed business case has been built for the time-based flow management programme in the United States. The business case has proven the benefit/cost ratio to be positive. Implementation of time-based metering can reduce airborne delay. This capability was estimated to provide over 320 000 minutes in delay reduction and $28.37 million in benefits to airspace users and passengers over the evaluation period.

Necessary system capability

Avionics

No avionics capability is required in support of the time-based metering for departure. For approach, time-based metering is mainly achieved through ATC speed clearance to adjust the aircraft sequence in the AMAN. This operation can be facilitated by requiring the aircraft to meet a CTA at a metering fix, relying on the aircraft required time of arrival function from current flight management system (FMS).

Ground systems

The key technological aspects include automation support for the synchronization of arrival sequencing, departure sequencing, and surface information; improve predictability of arrival flow, further hone sector capacity estimates, and management by trajectory. Less congested locations might not require extensive automation support to implement.

Both TBFM and arrival/departure management (AMAN/DMAN) application and existing technologies can be leveraged, but require site adaptation and maintenance.

Human factors considerations

ATM personnel responsibilities will not be affected directly. However, human factors have been taken into consideration during the development of the processes and procedures associated with this module. Where automation is to be used, the human-machine interface has been considered from both a functional and ergonomic perspective. The possibility of latent failures however, continues to exist and vigilance is requested during all implementation actions. It is further requested that human factor issues, identified during implementation, be reported to the international community through ICAO as part of any safety reporting initiative.

Training and qualification requirements

Automation support is needed for air traffic management in airspace with high demands. Thus, training is needed for ATM personnel.

Training in the operational standards and procedures are required for this module. Likewise, the qualifications requirements which form an integral part to the implementation of this module.

Reference documents and guidance materials

- European ATM Master Plan, Edition 1.0, March 2009, update in progress
- SESAR Definition Phase Deliverables
- TBFM Business Case Analysis Report
- NextGen Midterm Concept of Operations v.2.0
- RTCA Trajectory Operations Concept of Use

Module summary

<table>
<tr><td colspan="6"><u>Title of the Module:</u>
B0-15: Improve Traffic Flow Through Runway Sequencing (AMAN/DMAN)</td></tr>
<tr><td colspan="2"><u>Elements:</u>
1. AMAN
2. DMAN</td><td colspan="2"><u>Equipage/Air</u>
- Nil</td><td colspan="2"><u>Equipage/Ground</u>
- Automation support</td></tr>
<tr><td colspan="6">Implementation monitoring and intended performance impact</td></tr>
<tr><td rowspan="2"><u>Implementation progress</u>
1. Indicator:
Percentage of international aerodromes with AMAN/DMAN</td><td colspan="5">Qualitative performance benefits associated with five main KPAs only</td></tr>
<tr><td><u>KPA-Access/Equity</u>
Not Applicable</td><td><u>KPA-Capacity</u>
Time-based metering will optimize usage of terminal airspace and runway capacity.</td><td><u>KPA-Efficiency</u>
Efficiency is positively impacted as reflected by increased runway throughput and arrival rates.</td><td><u>KPA-Environment</u>
Not Applicable</td><td><u>KPA-Safety</u>
Not Applicable</td></tr>
</table>

<u>B0-65: Optimization of Approach Procedures including Vertical Guidance</u>

Introduction

This module complements other airspace and procedures elements (continuous descent operations (CDO), PBN and airspace management) to increase efficiency, safety, access and predictability.

The use of performance-based navigation (PBN) and ground-based augmentation system (GBAS) landing system (GLS1) procedures will enhance the reliability and predictability of approaches to runways, thus increasing safety, accessibility and efficiency. This is possible through the application of Basic global navigation satellite system (GNSS), Baro vertical navigation (VNAV), satellite-based augmentation system (SBAS) and GLS. The flexibility inherent in PBN approach design can be exploited to increase runway capacity.

Baseline

Conventional navigation aids (e.g. Instrument landing system (ILS), VHF omnidirectional radio range (VOR), non-directional radio beacon (NDB)) have limitations in their ability to support the lowest minima to every runway. In the case of ILS, limitations include cost, the availability of suitable sites for ground infrastructure and an inability to support multiple descent paths to multiple runway ends. VOR and NDB procedures do not support vertical guidance and have relatively high minima that depend on siting considerations.

Change brought by the module

With the exception of ground-based augmentation system (GBAS) for GLS, performance-based navigation (PBN) procedures require no ground-based navaids and allow designers complete flexibility in determining the final approach lateral and vertical paths. PBN approach procedures can be seamlessly integrated with PBN arrival procedures, along with continuous descent operations (CDO), thus reducing aircrew and controller workload and the probability that aircraft will not follow the expected trajectory.

With the exception of ground-based augmentation system (GBAS) for GLS, performance-based navigation (PBN) procedures require no ground-based navaids and allow designers complete flexibility in determining the final approach lateral and vertical paths. PBN approach procedures can be seamlessly integrated with PBN arrival procedures, along with continuous descent operations (CDO), thus reducing aircrew and controller workload and the probability that aircraft will not follow the expected trajectory.

States can implement GNSS-based PBN approach procedures that provide minima for aircraft equipped with basic GNSS avionics with or without Baro VNAV capability, and for aircraft equipped with SBAS avionics. GLS, which is not included in the PBN Manual, requires aerodrome infrastructure but a single station can support approaches to all runways and GLS offers the same design flexibility as PBN procedures. This flexibility provides benefits when conventional aids are out of service due to system failures or for maintenance. Regardless of the avionics fit, each aircraft will follow the same lateral path. Such approaches can be designed for runways with or without conventional approaches, thus providing benefits to PBN-capable aircraft, encouraging equipage and supporting the planning for decommissioning of some conventional aids.

The key to realizing maximum benefits from these procedures is aircraft equipage. Aircraft operators make independent decisions about equipage based on the value of incremental benefits and potential savings in fuel and other costs related to flight disruptions.

Metrics *to determine success of the module are proposed in the Manual on Global Performance of the Air Navigation System (Doc 9883).*

Intended performance operational improvement

In contrast with ILS, the GNSS-based approaches (PBN and GLS) do not require the definition and management of sensitive and critical areas resulting in potentially increased runway capacity.

Cost savings related to the benefits of lower approach minima: fewer diversions, overflights, cancellations and delays. Cost savings related to higher airport capacity in certain circumstances (e.g. closely spaced parallels) by taking advantage of the flexibility to offset approaches and define displaced thresholds.

This implementation contributes to safety with stabilized approach paths and to environment benefits through reduced fuel burn increasing airport accessibility as well.

In terms of cost benefit analysis Aircraft operators and air navigation service providers (ANSPs) can quantify the benefits of lower minima by using historical aerodrome weather observations and modelling airport accessibility with existing and new minima. Each aircraft operator can then assess benefits against the cost of any required avionics upgrade. Until there are GBAS (CAT I/III) Standards, GLS cannot be considered as a candidate to globally replace ILS. The GLS business case needs to consider the cost of retaining ILS or MLS to allow continued operations during an interference event.

Necessary procedures (air and ground)

The following documents provide background and implementation guidance for ANSPs, aircraft operators, airport operators and aviation regulators:

The Performance-based Navigation (PBN) Manual (Doc 9613), the Global Navigation Satellite System (GNSS) Manual (Doc 9849) Annex 10 — Aeronautical Telecommunications and the Procedures for Air Navigation Services — Aircraft Operations, Volume I — Flight Procedures and Volume II — Construction of Visual and Instrument Flight Procedures (PANS-OPS, Doc 8168) provide guidance on system performance, procedure design and flight techniques necessary to enable PBN approach procedures.

The World Geodetic System — 1984 (WGS-84) Manual (Doc 9674) provides guidance on surveying and data handling requirements. The Manual on Testing of Radio Navigation Aids (Doc 8071) (Doc 8071), Volume II — Testing of Satellite-based Radio Navigation Systems provides guidance on the testing of GNSS. This testing is designed to confirm the ability of GNSS signals to support flight procedures in accordance with the standards in Annex 10.

ANSPs must also assess the suitability of a procedure for publication, as detailed in PANS-OPS, Volume II, Part I, Section 2, Chapter 4, Quality Assurance. The Quality Assurance Manual for Flight Procedure Design (Doc 9906), Volume 5 –Validation of Instrument Flight Procedures provides the required guidance for validation of instrument flight procedures including PBN procedures. Flight validation for PBN procedures is less costly than for conventional aids for two reasons: the aircraft used do not require complex signal measurement and recording systems; and there is no requirement to check signals periodically.

Necessary system capability

Avionics

PBN approach procedures can be flown with basic instrument flight rules (IFR) GNSS avionics that support on board performance monitoring and alerting; these support lateral navigation (LNAV) minima. Basic IFR GNSS receivers may be integrated with Baro VNAV functionality to support vertical guidance to LNAV/vertical navigation (VNAV) minima. In States with defined SBAS service areas, aircraft with SBAS avionics can fly approaches with vertical guidance to LPV minima, which can be as low as ILS CAT I minima when flown to a precision instrument runway, and as low as 250 ft minimum descent altitude (MDA) when flown to an instrument runway. Within an SBAS service area, SBAS avionics can provide advisory vertical guidance when flying conventional non-directional beacon (NDB) and very high frequency omnidirectional radio range (VOR) procedures, thus providing the safety benefits associated with a stabilized approach. Aircraft require avionics to fly GBAS land system (GLS) approaches.

Ground systems

SBAS-based procedures do not require any infrastructure at the airport served, but SBAS elements (e.g. reference stations, master stations, geostationary (GEO) satellites) must be in place such that this level of service is supported. The ionosphere is very active in equatorial regions, making it very technically challenging for the current generation of SBAS to provide vertically guided approaches in these regions. A GLS station installed at the aerodrome served can support vertically guided CAT I approaches to all runways at that aerodrome.

Human performance

The implementation of approach procedures with vertical guidance enables improved cockpit resource management in times of high and sometime complex workload. By allowing crew procedures to be better distributed during the conduct of the procedure, exposure to operational errors is reduced and human performance is improved. This results in clear safety benefits over procedures that lack guidance along a vertical path. Additionally, some simplification and efficiencies may be achieved in crew training as well.

Human factors have been taken into consideration during the development of the processes and procedures associated with this module. Where automation is to be used, the human-machine interface has been considered from both a functional and ergonomic perspective. The possibility of latent failures, however, continues to exist and vigilance is requested during all implementation actions. It is further requested that human factor issues identified during implementation be reported to the international community through ICAO as part of any safety reporting initiative.

Training and qualification requirements

Training in the operational standards and procedures are required for this module and can be found in the Reference Documents and Guidance material section

in to this module. Likewise, the qualification requirements are identified in th Regulatory/standardization needs and Approval Plan (Air and Ground e section which form an integral part to the implementation of this module.

Regulatory/standardization needs and approval plan (air and ground)

1) Regulatory/standardization: use current published criteria as given in Section 8.4 as no new or updated regulatory guidance or standards documentation is needed at this time.
2) Approval plans: no new or updated approval criteria are needed at this time. Implementation plans should reflect available aircraft, ground systems and operational approvals.

Reference documents and guidance material

- ICAO Annex 10 — *Aeronautical Telecommunications*, Volume I — *Radio Navigation Aids*. As of 2011 a draft Standards and Recommended Practices (SARPs) amendment for GLS to support CAT II/III approaches is completed and is being validated by States and industry.
- ICAO Annex 11 — *Air Traffic Services*
- ICAO Doc 4444, *Procedures for Air Navigation Services — Air Traffic Management*
- ICAO Doc 8168, *Procedures for Air Navigation Services — Aircraft Operations*
- ICAO Doc 9674, *World Geodetic System — 1984 (WGS-84) Manual*
- ICAO Doc 9613, *Performance-based Navigation (PBN) Manual*
- ICAO Doc 9849, *Global Navigation Satellite System (GNSS) Manual*
- ICAO Doc 9906, *Quality Assurance Manual for Flight Procedure Design*, Volume 5 -*Validation of Instrument Flight Procedures*
- ICAO Doc 8071, *Manual on Testing of Radio Navigation Aids*, Volume II — *Testing of Satellite-based Radio Navigation Systems*
- ICAO Doc 9931, *Continuous Descent Operations (CDO) Manual*
- FAA AC 20-138, TSO-C129/145/146

Module summary

<table>
<tr><td colspan="6"><u>Title of the Module:</u>
B0-65: Optimization of Approach Procedures Including Vertical Guidance</td></tr>
<tr><td colspan="2"><u>Elements:</u>
1. APV with Baro VNAV
2. APV with SBAS
3. APV with GBAS</td><td colspan="2"><u>Equipage/Air</u>
- Basic IFR GNSS avionics integrated with Baro VNAV functionality
- SBAS avionics
- GBAS avionics</td><td colspan="2"><u>Equipage/Ground</u>
- SBAS (reference stations, master stations, GEO satellites)
- GBAS</td></tr>
<tr><td colspan="6">Implementation monitoring and intended performance impact</td></tr>
<tr><td rowspan="2"><u>Implementation progress</u>
1. 1. Indicator:
2. Percentage of international aerodromes having instrument runways provided with APV on the basis of
3. Baro VNAV/SBAS/GBAS</td><td colspan="5">Qualitative performance benefits associated with five main KPAs only</td></tr>
<tr><td><u>KPA-Access/Equity</u>
Increased aerodrome accessibility</td><td><u>KPA-Capacity</u>
Increased runway capacity</td><td><u>KPA-Efficiency</u>
Reduced fuel burn due to lower minima, fewer diversions, cancellations, delays</td><td><u>KPA-Environment</u>
Reduced emissions due to reduced fuel burn.</td><td><u>KPA-Safety</u>
Increased safety through stabilized approach paths.</td></tr>
</table>

B0-75: Safety and Efficiency of Surface Operations (A-SMGCS Level 1-2)

Introduction

This module builds upon traditional surface movement guidance and control system (SMGCS) implementation (visual surveillance, aerodrome signage, lighting and markings) by the introduction of capabilities enhancing air traffic control (ATC) situational awareness through:

a) display to the aerodrome controller of the position of all aircraft on the aerodrome movement area;
b) display to the aerodrome controller of all vehicles on the aerodrome maneuvering area; and
c) generation of runway incursion alerts (where local operational, safety and cost- benefit analyses so warrant).

This level of implementation, corresponding to levels 1 and 2 of the A-SMGCS concept and being associated to the provision of ATS, is independent of aircraft equipage beyond that associated with cooperative surveillance equipage (e.g. SSR Mode S or A/C transponders).

For automatic dependent surveillance—broadcast (ADS-B) APT the facilities and procedures will be the same with the performance levels associated to conventional SMGCS. The B0 level of implementation is dependent of aircraft/vehicle ADS-B Out equipage.

Baseline

Surface operations historically have been managed by use of visual scanning by both ANSP personnel and flight crew, both as the basis for taxi management as well as aircraft navigation and separation. These operations are significantly impeded during periods of reduced visibility (weather obscuration, night) and high demand, e.g. when a large proportion of aircraft are from the same operator and/or of the same aircraft type.

In addition, remote areas of the aerodrome surface are difficult to manage if out of direct visual surveillance. As a result, efficiency can be significantly degraded, and safety services are unevenly provided. Complementary to such historical means of aerodrome traffic management, enhanced surface situational awareness has been based upon use of an aerodrome surface movement primary radar system and display (SMR). This permits the surveillance of all aircraft and ground vehicles without any need for cooperative surveillance equipment installed on the aircraft/vehicles. This improvement allows ANSP personnel to better maintain awareness of ground operations during periods of low visibility. In addition, the presence of safety logic allows for limited detection of runway incursions.

Change brought by the module

This module implements:

a) additional capabilities to the aerodrome surveillance environment by taking advantage of cooperative surveillance that provides the means to establish the position of all aircraft and vehicles and to specifically identify targets with individual flight/vehicle identification. Ground vehicles operating on the maneuvering area will be equipped with cooperative surveillance transponders compatible with the specific A-SMGCS equipment installed so as to be visible to tower ground surveillance display systems; and
b) SMR-like capabilities by implementing ADS-B APT at those aerodromes where surveillance is not available.

Element 1 – Surveillance

In the case of A-SMGCS, this element enhances the primary radar surface surveillance with the addition of at least one cooperative surface surveillance system. These systems include multi-lateration, secondary surveillance radar Mode S, and ADS-B. As with TMA and en-route secondary surveillance radars/ADS-B, the cooperative aspect of the surveillance allows for matching of equipped surveillance targets with flight data, and also reduces clutter and degraded operation associated with primary surveillance. The addition of cooperative surveillance of aircraft and vehicles adds a significant positive benefit to the performance of safety logic, as the tracking and short-term trajectory projection capabilities are improved with the higher quality surveillance. The addition of this capability also provides for a marginal improvement in routine management of taxi operations and more efficient sequencing of aircraft departures.

In the case of ADS-B APT, as an element of an A-SMGCS system, it provides controllers with traffic situational awareness on movement areas. The provision of surveillance information to the controller will allow the deployment of SMGCS procedures, augmenting the controller‘s situational awareness and helping the controller to manage the traffic in a more efficient way. In this respect, the ADS-B APT application does not aim to reduce the occurrence of runway incursions, but may reduce the occurrence of runway collisions by assisting in the detection of the incursions.

Element 2 – Alerting

In the case of A-SMGCS, where installed and operated, alerting with flight identification information also improves the ATC response to situations that require resolution such as runway incursion incidents and improved response times to unsafe surface situations. Levels of sophistication as regards this functionality currently vary considerably between the various industrial solutions being offered. B0 implementations will serve as important initial validation for improved algorithms downstream.

In the case of ADS-B APT, system generated alerting processes and procedures have not been defined (as this is considered premature at this development stage). It is possible that future variations of the ADS-B APT application will assess the surveillance requirements necessary to support alerting functions.

Intended performance operational improvement

The A-SMGCS improves access to portions of the manoeuvring area obscured from view of the control tower for vehicles and aircraft. It also sustains an improved aerodrome capacity during periods of reduced visibility and ensures equity in ATC handling of surface traffic regardless of the traffic‘s position on the aerodrome.

The ADS-B APT as an element of an A-SMGCS system, provides traffic situational awareness to the controller in the form of surveillance information and potentially improves capacity. The availability of the data is dependent on the aircraft and vehicle level of equipage.

In terms of efficiency A-SMGCS reduce taxi times through diminished requirements for intermediate holdings based on reliance on visual surveillance only and ADS-B APT potentially reduces taxi times by providing improved traffic situational awareness to controllers.

Cost benefit analysis is positive taking into consideration the improved levels of safety and improved efficiencies in surface operations leading to significant savings in aircraft fuel usage. As well, aerodrome operator vehicles will benefit from improved access to all areas of the aerodrome, improving the efficiency of aerodrome operations, maintenance and servicing.

This implementation reduces ATC workload and improve ATC efficiency.

Necessary system capability

Avionics

Existing aircraft ADS-B and/or SSR transponder systems, including correct setting of aircraft identification.

Vehicles

Vehicle cooperative transponder systems, type as a function of the local A-SMGCS installation. Industry solutions readily available.

Ground systems

A-SMGCS: the surface movement radar should be complemented by a cooperative surveillance means allowing tracking aircraft and ground vehicles. A surveillance display including some alerting functionalities is required in the tower.

ADS-B APT: cooperative surveillance infrastructure deployed on the aerodrome surface; installation of a tower traffic situational awareness display.

Human performance

Human factors considerations

Workload analyses will be necessary to ensure ATC can cope with increased aerodrome capacities in reduced visual conditions using A-SMGCS. ATC response to A-SMGCS generated runway incursion alarms and warnings will require human factors assessments to ensure that ATC performance in this regard does in fact improve and not diminish. Human factors assessments will also be necessary for the assessment of the compatibility of A-SMGCS tower display installations with other tower surveillance display systems.

Human factors have been taken into consideration during the development of the processes and procedures associated with this module. Where automation is to be used, the human-machine interface has been considered from both a functional and ergonomic perspective (see Section 6 for examples). The possibility of latent failures however, continues to exist and vigilance is requested during all implementation actions. It is further requested that human factor issues, identified during implementation, be reported to the international community through ICAO as part of any safety reporting initiative.

Training and qualification requirements

Training in the operational standards and procedures are required for this module and can be found in the links to the documents in Reference Documents and Guidance material to this module. Likewise, the qualifications requirements are identified in the Regulatory/standardization r needs and Approval Plan (Air and Ground)which form an integral part to the implementation of this module.

Regulatory/standardization needs and approval plan (air and ground)

Standards approved for aerodrome multilateration, ADS-B and safety logic systems exist for use in Europe, the United States and other Member States. Standards for surface movement radar (SMR) exist for use globally.

Reference documents and guidance material

- Community Specification on A-SMGCS Levels 1 and 2
- ICAO Doc 4444, *Procedures for Air Navigation Services — Air Traffic Management*
- ICAO Doc 7030, *Regional Supplementary Procedures* (EUR SUPPS)
- ICAO Doc 9924, *Aeronautical Surveillance Manual*
- ICAO Doc 9871, *Technical Provisions for Mode S Services and Extended Squitter*
- ICAO Doc 9830, *Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Manual*
- ICAO Doc 7030/5, (EUR/NAT) *Regional Supplementary Procedures*, Section 6.5.6 and 6.5.7
- FAA Advisory Circulars
- AC120-86 Aircraft Surveillance Systems and Applications
- AC120-28D Criteria for approval of Category III Weather Minima for Take-off, Landing, and Rollout
- AC120-57A Surface Movement Guidance and Control System
- Avionics standards developed by RTCA SC-186/Eurocae WG-51 for ADS-B
- Aerodrome map standards developed by RTCA SC-217/Eurocae WG-44
- EUROCAE ED 163 Safety, Performance and Interoperability Requirements document for ADS-B Airport Surface surveillance application (ADS-B APT)
- FAA NextGen Implementation Plan
- European ATM Master Plan

Module summary

<table>
<tr><td colspan="3"><u>Title of the Module:</u>
B0-75: Safety and Efficiency of Surface Operations (A-SMGCS Level 1-2)</td></tr>
<tr><td><u>Elements</u>
1. Surveillance
2. Alerting systems
3. (Not included in the Module but added here as they are closely linked to this Module) Visual aids for navigation and Wild life strike hazard reduction</td><td><u>Equipage/Air</u>
- ADS-B / SSR transponder system</td><td><u>Equipage/Ground</u>
- SMR/SSR Mode S/ ADS B/ Multilateration
- Surveillance display with alerting functionalities in the tower.
- A cooperative transponder system for vehicles
- Visual aids for navigation</td></tr>
<tr><td colspan="3">Implementation monitoring and intended performance impact</td></tr>
<tr><td><u>Implementation</u></td><td colspan="2">Qualitative performance benefits associated with five main KPAs only</td></tr>
</table>

progress 1. Indicator: *Percentage of international aerodromes with SMR/ SSR Mode S/ ADS-B Multilateration* 2. Indicator: *Percentage of international aerodromes with a cooperative transponder systems on vehicles* 3. Indicator: *Percentage of international aerodromes complying with visual aid requirements as per Annex 14*	KPA-Access/Equity Improves KPA-Access/Equity to portions of the manoeuvring area obscured from view of the control tower for vehicles and aircraft. Ensures equity in ATC handling of surface traffic regardless of the traffic's position on the international aerodrome.	KPA-Capacity Sustained level of aerodrome capacity during periods of reduced visibility	KPA-Efficiency Reduced taxi times through diminished requirements for intermediate holdings based on reliance on visual surveillance only. Reduced fuel burn.	KPA-Environment Reduced emissions due to reduced fuel burn	KPA-Safety Reduced runway incursions. Improved response to unsafe situations. Improved situational awareness leading to reduced ATC workload.

B0-80: Improved Airport Operations through Airport-CDM

Introduction

This module is designed to implement collaborative applications that will allow the sharing of surface operations data among the different stakeholders on the airport. This will improve surface traffic management reducing delays on movement and maneuvering areas and enhance safety, efficiency and situational awareness

Baseline

Surface operations, especially for the turnaround phase, involve all operational stakeholders at an airport. They each have their own processes that are conducted as efficiently as possible. However, by relying on separated systems and not sharing all relevant information, they currently do not perform as efficiently as they could.

The baseline will be operations without airport collaboration tools and operations.

Change brought by the module

Implementation of airport collaborative decision making (A-CDM) will enhance surface operations and safety by making airspace users, ATC and airport operations better aware of their respective situation and actions on a given flight.

Airport-CDM is a set of improved processes supported by the interconnection of various airport stakeholders information systems. Airport-CDM can be a relatively simple and low cost programme.

Intended performance operational improvement

In terms of capacity this module enhanced use of existing infrastructure of gate and stands (unlock latent capacity) and reduced workload, and assure a better organization of the activities to manage flights.

It also increases efficiency of the ATM system for all stakeholders. In particular for aircraft operators: improved situational awareness (aircraft status both home and away); enhanced fleet predictability and punctuality; improved operational efficiency (fleet management); and reduced delay.

Environmental benefits are achieved with this implementation reducing taxi time, fuel and carbon emissions and lower aircraft engine run time

The business case has proven to be positive due to the benefits that flights and the other airport operational stakeholders can obtain. However, this may be influenced depending upon the individual situation (environment, traffic levels investment cost, etc.).

Necessary procedures (air and ground)

The existing procedures need to be adapted to the collaborative environment in order to provide full benefits. These changes will affect the way the pilot, controller, airlines operations and ATFM unit will exchange information and manage the departing queue. The pushback and engine start up are just in time taking in account assigned runway, taxiing time, runway capacity, departure slot and departure constraints.

Necessary system capability

Avionics

No airborne equipment is required.

Ground systems

Collaborative decision-making (CDM) does not require specific new functionalities. The difficulty is more to interconnect ground systems depending on the systems in place locally but experience has proven that industrial solutions/support exist. Where available, shared surveillance information may enhance operations.

Human factors considerations

Human factors have been taken into consideration during the development of the processes and procedures associated with this module. Where automation is to be used, the human-machine interface has been considered from both a functional and ergonomic perspective. The possibility of latent failures however, continues to exist and vigilance is requested during all implementation actions. It is further requested that human factor issues, identified during implementation, be reported to the international community through ICAO as part of any safety reporting initiative.

Training and qualification requirements

Training in the operational standards and procedures are required for this module and can be found in the links to the documents in Reference Documents and Guidance material section. Likewise, the qualifications requirements are identified in the regulatory requirements in Regulatory/standardization needs and Approval Plan (Air and Ground) section which form an integral part to the implementation of this module.

Regulatory/standardization needs and approval plan (air and ground)

Regulatory/standardization: updates are required to the following current published criteria:

- ICAO Doc 4444, *Procedures for Air Navigation Services — Air Traffic Management*
- ICAO *CDM Manual*

Approval plans: updates are required for:

- EUROCONTROL, A-CDM Implementation Manual
- FAA NextGen Implementation Plan

Reference documents and guidance material

- ICAO CDM Manual (being finalized)
- European Union, OJEU 2010/C 168/04: Community Specification ETSI EN 303 212 v.1.1.1: European Standard (Telecommunications series) Airport Collaborative Decision Making (A-CDM)
- EUROCAE ED-141: Minimum Technical Specifications for Airport Collaborative Decision Making (Airport-CDM) Systems
- EUROCONTROL A-CDM Programme documentation, including an Airport - CDM Implementation Manual
- FAA NextGen Implementation Plan 2011

Module summary

<table>
<tr><td colspan="6"><u>Title of the Module:</u>
B0-80: Improved Airport Operations through Airport-CDM</td></tr>
<tr><td colspan="2"><u>Elements:</u>
1. Airport –CDM
2.(Not included in the Module but added here as they are closely linked to this Module) Aerodrome certification, Aerodrome emergency planning, Airport planning and Heliport operations</td><td colspan="2"><u>Equipage/Air</u>
- Nil</td><td colspan="2"><u>Equipage/Ground</u>
- Interconnection of ground systems of different partners for Airport-CDM
- Rescue and Fire Fighting (RFF) Equipment as per Annexe 14</td></tr>
<tr><td colspan="6">Implementation monitoring and intended performance impact</td></tr>
<tr><td rowspan="2"><u>Implementation progress</u>
1. Indicator: percentage of international aerodromes with Airport-CDM

2. Indicator: Percentage of certified international aerodromes

3. Indicator: Percentage of international aerodromes with RFF equipment as per Annex 14</td><td colspan="5">Qualitative performance benefits associated with five main KPAs only</td></tr>
<tr><td><u>KPA-Access/Equity</u>
Enhances equity on the use of aerodrome facilities.</td><td><u>KPA-Capacity</u>
Enhanced use of existing Implementation of gate and stands (unlock latent capacity). Reduced workload, better organization of the activities to manage flights.</td><td><u>KPA-Efficiency</u>
Improved operational efficiency (fleet management); and reduced delay. Reduced fuel burn due to reduced taxi time and lower aircraft engine run time.</td><td><u>KPA-Environment</u>
Reduced emissions due to reduced fuel burn</td><td><u>KPA-Safety</u>
Not Applicable</td></tr>
</table>

PERFORMANCE IMPROVEMENT AREA 2: GLOBALLY INTEROPERABLE SYSTEMS AND DATA

B0-25: Increased Interoperability, Efficiency and Capacity through Ground-Ground Integration

Introduction

This module was designed to improve coordination between air traffic service units (ATSUs) by using ATS interfacility data communication (AIDC) defined by the ICAO Manual of Air Traffic Services Data Link Applications (Doc 9694). The transfer of communication in a data link environment improves the efficiency of this process particularly for oceanic ATSUs.

Baseline

The baseline for this module is the traditional coordination by phone, and procedural and/or radar distance/time separations.

Flights which are being provided with air traffic services are transferred from one air traffic services (ATS) unit to the next in a manner designed to ensure safety. In order to accomplish this objective, it is a standard procedure that the passage of each flight across the boundary of the areas of responsibility of the two units is coordinated between them beforehand and that the control of the flight is transferred when it is at, or adjacent to, the said boundary.

Where it is carried out by telephone, the passing of data on individual flights as part of the coordination process is a major support task at ATS units, particularly at area control centres (ACCs). The operational use of connections between flight data processing systems (FDPSs) at ACCs replacing phone coordination (on-line data interchange (OLDI)) is already proven in Europe.

This is now fully integrated into the ATS interfacility data communications (AIDC) messages in the *Procedures for Air Navigation Services — Air Traffic Management*, (PANS-ATM, Doc 4444) which describes the types of messages and their contents to be used for operational communications between ATS unit computer systems. This type of data transfer (AIDC) will be the basis for migration of data communications to the aeronautical telecommunication network (ATN).

Information exchanges between flight data processing systems are established between air traffic services units for the purpose of notification, coordination and transfer of flights and for the purpose of civil/military coordination.

These information exchanges rely upon appropriate and harmonized communication protocols to secure their interoperability and apply to:

a) communication systems supporting the coordination procedures between air traffic services units using a peer-to-peer communication mechanism and providing services to general air traffic; and
b) communication systems supporting the coordination procedures between air traffic services units and controlling military units, using a peer-to-peer communication mechanism.

Change brought by the module

The module makes available a set of messages to describe consistent transfer conditions via electronic means across boundaries of ATS units. It consists of the implementation of the set of AIDC messages in the flight data processing systems (FDPS) of the different ATS units involved and the establishment of a Letter of Agreement (LoA) between these units to set the appropriate parameters.

Prerequisites for the module, generally available before its implementation, are an ATC system with flight data processing functionality and a surveillance data processing system connected to each other. This module is a first step towards the more sophisticated 4D trajectory exchanges between both ground/ground and air/ground according to the ICAO *Global Air Traffic Management Operational Concept* (Doc 9854).

Intended performance operational improvement

Metrics to determine the success of the module are proposed in the *Manual on Global Performance of the Air Navigation System* (Doc 9883).

In terms of capacity this implementation reduced controller workload and increased data integrity supporting reduced separations translating directly to cross sector or boundary capacity flow increases.

This reduced separation can also be used to more frequently offer aircraft flight levels closer to the flight optimum; in certain cases, this also translates into reduced en-route holding contributing to efficiency.

Additionally in terms of safety the Air Traffic Controllers also, have a better knowledge of more accurate flight plan information reducing errors in the ATC loop coordination.

Increase of throughput at ATS unit boundary and reduced ATCO workload will outweigh the cost of FDPS software changes. The business case is dependent on the environment.

Necessary procedures (air and ground)

Required procedures exist. They need local analysis of the specific flows and should be spelled out in a Letter of Agreement between ATS units; the experience from other regions can be a useful reference.

Avionics

No specific airborne requirements.

Ground systems

Technology is available. It consists in implementing the relevant set of AIDC messages in flight data processing and could use the ground network standard AFTN-AMHS or ATN. Europe is presently implementing it in ADEXP format over IP wide area networks.

The technology also includes for oceanic ATSUs a function supporting transfer of communication via data link.

Human factors considerations

Ground interoperability reduces voice exchange between ATCOs and decreases workload. A system supporting appropriate human-machine interface (HMI) for ATCOs is required.

Human factors have been taken into consideration during the development of the processes and procedures associated with this module. Where automation is to be used, the HMI has been considered from both a functional and ergonomic perspective (see Section 6 for examples). The possibility of latent failures, however, continues to exist and vigilance is required during all implementation activity. In addition it is important that human factor issues, identified during implementation, be reported to the international community through ICAO as part of any safety reporting initiative.

Training and qualification requirements

To make the most of the automation support, training in the operational standards and procedures will be required and can be found in the links to the documents in Reference Documents and Guidance material section

of this module. Likewise, the qualifications requirements are identified in the regulatory requirements in the Regulatory/standardization needs and Approval Plan (Air AND Ground) section which are integral to the implementation of this module**.**

Regulatory/standardization needs and approval plan (air AND ground)

Regulatory/standardization: use current published criteria that include:

a) ICAO Doc 4444, *Procedures for Air Navigation Services — Air Traffic Management*; and
b) EU Regulation, EC No 552/2004.

Approval plans: to be determined based on regional consideration of ATS interfacility data communications (AIDC).

Reference documents and guidance material

- ICAO Doc 4444, *Procedures for Air Navigation Services* **-** *Air Traffic Management*, Appendix 6 **-** *ATS Interfacility Data Communications (AIDC) Messages*

- ICAO Doc 9880, *Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI Standards and Protocols*, Part II — *Ground-Ground Applications — Air Traffic Services Message Handling Services (ATSMHS).*
- ICAO Doc 9694, *Manual of Air Traffic Services Data Link Applications;* Part 6;
- GOLD Global Operational Data Link Document (APANPIRG, NAT SPG), June 2010;
- Pan Regional Interface Control Document for Oceanic ATS Interfacility Data Communications (PAN ICD) Coordination Draft Version 0.3. 31 August 2010;
- Asia/Pacific Regional Interface Control Document (ICD) for ATS Interfacility Data Communications (AIDC) available at http://www.bangkok.icao.int/edocs/icd_aidc_ver3.pdf, ICAO Asia/Pacific Regional Office.
- EUROCONTROL Standard for On-Line Data Interchange (OLDI); and EUROCONTROL Standard for ATS Data Exchange Presentation (ADEXP).

Procedures

To be determined.

Module summary

<table>
<tr><td colspan="6"><u>Title of the Module:</u>
B0-25: Increased Interoperability, Efficiency and Capacity through Ground-Ground Integration</td></tr>
<tr><td colspan="2"><u>Elements:</u>
1. AIDC
2. (Not included in the Module but added here as they are closely linked to this Module) AMHS/IPS</td><td colspan="2"><u>Equipage/Air</u>
- Nil</td><td colspan="2"><u>Equipage/Ground</u>
- A set of AIDC messages in FDPS
- AFTN (AMHS/IPS)</td></tr>
<tr><td colspan="6">Implementation monitoring and intended performance impact</td></tr>
<tr><td rowspan="2"><u>Implementation progress</u>
1. Indicator: Percentage of ATS units with AIDC

2. Indicator: States implementing AMHS/IPS</td><td colspan="5">Qualitative performance benefits associated with five main KPAs only</td></tr>
<tr><td><u>KPA-Access/Equity</u>
Not Applicable</td><td><u>KPA-Capacity</u>
Reduced controller workload and increased data integrity supporting reduced separations translating directly to cross sector or boundary capacity flow increases.</td><td><u>KPA-Efficiency</u>
The reduced separation can also be used to more frequently offer aircraft flight levels closer to the optimum; in certain cases, this also translates into reduced en-route holding.</td><td><u>KPA-Environment</u>
Not Applicable</td><td><u>KPA-Safety</u>
Better knowledge of more accurate flight plan information.

.</td></tr>
</table>

<u>B0-30: Service Improvement through Digital Aeronautical Information Management</u>

Introduction

The Eleventh Air Navigation Conference (2003) recommended the urgent adoption of a common aeronautical exchange model which took into account operational systems and concepts of data interchange, including specifically aeronautical information conceptual model/aeronautical information exchange model (AICM/AIXM), and addressed their mutual interoperability.

The move from aeronautical information service (AIS) to aeronautical information management (AIM), and from paper to electronic media, is already well supported by standardized formats based on widely used information technology standards (UML, XML/GML) operating on commonplace technology products and electronic storage.

The expectations are that the transition to AIM will not involve many changes in terms of the scope of information to be distributed. The major change will be the increased emphasis on data distribution, which should place the future AIM in a position to better serve airspace users and air traffic management (ATM) in terms of their information management requirements.

This module describes the planning to initial introduction of digital processing and management of information, through aeronautical information service (AIS)/aeronautical information management (AIM) implementation, use of aeronautical information exchange model (AIXM), migration to electronic aeronautical information publication (AIP) and better quality and availability of data.

In the short- to medium-term, the focus is on the continuing transition of the services provided by aeronautical information services (AIS) from a product-centred, paper-based and manually-transacted focus to a digitally-enabled, network-centred and service-oriented aeronautical information management (AIM) focus. AIM envisages a migration to a data centric environment where aeronautical data will be provided in a digital form and in a managed way.

Baseline

The baseline is the traditional provision of aeronautical information, based on paper publications and NOTAMs.

AIS information provided by SAM States has traditionally been based on paper documents and text messages (NOTAM) and maintained and distributed as such. In spite of manual verifications, this did not always prevent errors or inconsistencies. In addition, the information had to be transcribed from paper to automated ground and airborne systems, thus introducing additional risks. Finally, the timeliness and quality of required information updates could not always be guaranteed.

Change brought by the module

This module continues the transition of AIS from traditional product provision to a digitally enabled service oriented environment with information exchange utilizing standardized formats based on widely used information technology standards (UML, XML/GML). This will be supported by industrial products and stored on electronics devices. Information quality is increased, as well as that of the management of aeronautical information in general. The AIP moves from paper to electronic support.

Intended performance operational improvement

Metrics to determine the success of the module are proposed in the *Manual on Global Performance of the Air Navigation System* (Doc 9883).

This implementation reduces costs in terms of data inputs and checks, paper and post, especially when considering the overall data chain, from originators, through AIS to the end users. It also reduces the time necessary to promulgate information concerning airspace status that allow for more effective airspace utilization and allow improvements in trajectory management.

There is an essential contribution to interoperability and safety also, due to the reduction in the number of possible inconsistencies, reducing a several number of manual entries and ensures consistency among data through automatic data checking based on commonly agreed business rules.

The business case for the aeronautical information conceptual model (AIXM) has been conducted in Europe and in the United States and has shown to be positive. The initial investment necessary for the provision of digital AIS data may be reduced through regional cooperation and it remains low compared with the cost of other ATM systems. The transition from paper products to digital data is a critical pre-requisite for the implementation of any current or future ATM or air navigation concept that relies on the accuracy, integrity and timeliness of data.

Necessary procedures (air and ground)

No new procedures for air traffic control are required, but the process for AIS needs to be revisited. To obtain the full benefit, new procedures will be required for data users in order to retrieve the information digitally, for example, to allow airlines provide digital AIS data to on-board devices, in particular electronic flight bags (EFBs).

Avionics

No avionics requirements.

Ground systems

The aeronautical information is made available to AIS through digital processes and to external users via either a subscription to an electronic access or physical delivery; the electronic access can be based on Internet protocol services. The physical support does not need to be standardized. The main automation functions that need to be implemented to support provision of electronic AIS are the national aeronautical data, NOTAM (both national and international) and meteorological management including data collection, verification and distribution.

Human factors considerations

The automated assistance is well accepted and proven to reduce errors in manual transcription of data.

Human factors have been taken into consideration during the development of the processes and procedures associated with this module. Where automation is to be used, the human- machine interface has been considered from both a functional and ergonomic perspective. The possibility of latent failure however, continues to exist and vigilance is requested during all implementation actions. It is further requested that human factor issues, identified during implementation, be reported to the international community through ICAO as part of any safety reporting initiative.

Training and qualification requirements

Training is required for AIS/AIM personnel.

Regulatory/standardization needs and approval plan (air and ground)

- Regulatory/standardization: current published requirements
- Approval plans: to be determined, based upon regional applications.

Reference documents and guidance material

- ICAO Doc 8126, *Aeronautical Information Services Manual*, including AIXM and eAIP as per Third Edition
- ICAO Doc 8697, *Aeronautical Chart Manual*
- *Roadmap for the Transition from AIS to AIM*
- Manuals on AIM quality system and AIM training.

Note: Further changes to ICAO Annex 15 – *Aeronautical Information Services* are in preparation.

Procedures

In preparation.

Module summary

Title of the Module: **B0-30: Service Improvement through Digital Aeronautical Information Management**		
Elements: 1. AIXM 2. eAIP 3. Digital NOTAM 4.(Not included in the Module but added here as they are closely linked to this Module) WGS-84; eTOD; and QMS for AIM	Equipage/Air - Nil	Equipage/Ground AIXM; eAIP and Digital NOTAM WGS-84; eTOD; QMS for AIM The aeronautical information is made available to external users via either a subscription to an electronic access or physical delivery; The electronic access can be based on Internet protocol services.
Implementation monitoring and intended performance impact		

Implementation progress	Qualitative performance benefits associated with five main KPAs only				
1. Indicator: *States implementing AIXM; eAIP, Digital NOTAM WGS-84; eTOD; QMS for AIM*	KPA-Access/Equity Not Applicable	KPA-Capacity Not Applicable	KPA-Efficiency Not Applicable	KPA-Environment Reduced amount of paper for promulgation of information	KPA-Safety Reduction in the number of possible inconsistencies

B0-105: Meteorological information supporting enhanced operational efficiency and safety

General

Elements 1 to 3 of this module illustrate the meteorological information made available by world area forecast centers (WAFC), volcanic ash advisory centers (VAAC) and tropical cyclone advisory centers (TCAC) that can be used by the air traffic management (ATM) community to support dynamic and flexible management of airspace, improved situational awareness and collaborative decision making, and (in the case of WAFS forecasts) dynamically-optimized flight trajectory planning.

Elements 4 and 5 of this module illustrate the meteorological information issued by aerodrome meteorological offices in the form of aerodrome warnings, wind shear warnings and alerts (including those generated by automated meteorological systems) that contribute to improving safety and maximizing runway capacity. In some instances, the systems used for the detection of wind shear (such as ground based LIDAR) have proven utility in wake turbulence detection and tracking/monitoring, and thus also support the improving safety and maximizing runway capacity from a wake turbulence encounter prevention perspective. Additionally Element 6 of this module describes SIGMET which is meteorological information provided by a Meteorological Watch Office (WMO) on severe observed or expected events of turbulence, icing thunderstorm, volcanic ash, etc. that are considered an immediate hazard to aircraft en-route.

It should be recognized that elements 1 to 6 herein represent a subset of all available meteorological information that can be used to support enhanced operational efficiency and safety. Other such meteorological information that is not described here includes, for example, meteorological observations, reports and forecasts, aircraft observations and reports, and aeronautical climatological information.

Baseline

WAFCs within the framework of the world area forecast system (WAFS) prepare global gridded forecasts of upper wind, upper-air temperature and humidity, geopotential altitude of flight levels, flight level and temperature of tropopause, direction, speed and flight level of maximum wind, cumulonimbus clouds, icing, and clear-air and in-cloud turbulence. These global gridded forecasts are issued 4-times per day, with fixed time validity T+0 to T+36 at 3-hour time-steps. In addition, the WAFCs prepare global forecasts of significant weather (SIGWX) phenomena in binary code form. These global forecasts of SIGWX phenomena are issued 4-times per day, with validity at T+24. The United Kingdom and United States are designated as WAFC provider States. Accordingly, WAFCs London and Washington make available the aforementioned forecasts on the ICAO Aeronautical Fixed Service (AFS).

VAACs within the framework of the International Airways Volcano Watch (IAVW) respond to a notification that a volcano has erupted, or is expected to erupt or volcanic ash is reported in its area of responsibility. The VAACs monitor relevant satellite data to detect the existence and extent of volcanic ash in the atmosphere in the area concerned, and activate their volcanic ash numerical trajectory/dispersion model in order to forecast the movement of any ash cloud that has been detected or reported. In support, the VAACs also use surface-based observations and pilot reports to assist in the detection of volcanic ash. The VAACs issue advisory information (in plain language textual form and graphical form) concerning the extent and forecast movement of the volcanic ash cloud, with fixed time validity T+0 to T+18 at 6-hour time-steps. The VAACs issue these forecasts at least every six hours until such time as the volcanic ash cloud is no longer identifiable from satellite data, no further reports of volcanic ash are received from the area, and no further eruptions of the volcano are reported. The VAACs maintain a 24-hour watch. Argentina, Australia, Canada, France, Japan, New Zealand, the United Kingdom and the United States are designated (by regional air navigation agreement) as the VAAC provider States. Accordingly, VAACs Buenos Aires, Darwin, Montreal, Toulouse, Tokyo, Wellington, London, Anchorage and Washington make available the aforementioned advisories on the ICAO AFS.

TCACs monitor the development of tropical cyclones in their area of responsibility, using relevant satellite data, meteorological radar data and other meteorological information. The TCACs are meteorological centres designated by regional air navigation agreement on the advice of the World Meteorological Organization (WMO). The TCACs issue advisory information (in plain language textual form and graphical form) concerning the position of the tropical cyclone center, its direction and speed of movement, central pressure and maximum surface wind near the center, with fixed time validity T+0 to T+24 at 6-hour time-steps. The TCACs issue updated advisory information for each tropical cyclone, as necessary, but at least every six hours. Australia, Fiji, France, India, Japan and the United States are designated (by regional air navigation agreement) as TCAC provider States. Aforementioned advisories are made available on the ICAO AFS, through TCACs located in Darwin, Nadi, La Reunion, New Delhi, Tokyo, Honolulu and Miami.

Aerodrome warnings provide concise information of observed or expected meteorological conditions that could adversely affect aircraft on the ground, including parked aircraft, and the aerodrome facilities and services.

Wind shear warnings are prepared for aerodromes where wind shear is considered a factor. Wind shear warnings give concise information on the observed or expected existence of wind shear which could adversely affect aircraft on the approach path or take-off path or during circling approach between runway level and 500 m (1 600 ft) above that level and aircraft on the runway during the landing roll or take-off run. Note that where local topography has been shown to produce significant wind shears at heights in excess of 500 m (1 600 ft) above runway level, then 500 m (1,600 ft) is not to be considered restrictive.

SIGMETs are information that describes the location of specified en-route weather phenomena which may affect the safety of aircraft operations. SIGMETs are issued by MWOs for such phenomena as thunderstorms, turbulence, icing, mountain wave, radiation, volcanic ash and tropical cyclone. The latter two categories of SIGMETs are based on information provided in the appropriate advisories from the respective VAACs and TCACs.

Change brought by the module

The global availability of meteorological information as provided with the framework of the WAFS and IAVW enhances the pre-tactical and/or tactical decision making for aircraft surveillance, air traffic flow management and flexible/dynamic aircraft routing. Similar information is also provided by TCACs and MWOs in support of ATM decisions. The locally-arranged availability of aerodrome warnings, wind shear warnings and alerts (where wind shear is considered a factor), contributes to improved safety and maximized runway capacity during adverse meteorological conditions. Wind shear detection systems can, in some instances, be utilized for wake turbulence detection and tracking/monitoring.

Change brought by the module

The global availability of meteorological information as provided with the framework of the WAFS and IAVW enhances the pre-tactical and/or tactical decision making for aircraft surveillance, air traffic flow management and flexible/dynamic aircraft routing. Similar information is also provided by TCACs and MWOs in support of ATM decisions. The locally-arranged availability of aerodrome warnings, wind shear warnings and alerts (where wind shear is considered a factor), contributes to improved safety and maximized runway capacity during adverse meteorological conditions. Wind shear detection systems can, in some instances, be utilized for wake turbulence detection and tracking/monitoring.

Element 1: WAFS

The WAFS is a worldwide system within which two designated WAFCs provide aeronautical meteorological en-route forecasts in uniform standardized formats. The grid point forecasts are prepared by the WAFCs in a regular grid with a horizontal resolution of 1.25 degrees of latitude and longitude, and issued in binary code form using the GRIB code form as prescribed by WMO. The significant weather (SIGWX) forecasts are issued by the WAFCs in accordance with the provisions in Annex 3 — Meteorological Service for International Air Navigation (Chapter 3 and Appendix 2) in binary code form using the BUFR code form prescribed by WMO and in PNG-chart form as formalized backup means. ICAO administers the WAFS with the cooperation of the WAFC provider States and concerned international organizations through the World Area Forecast System Operations Group (WAFSOPSG).

Element 2: IAVW

The IAVW ensures international arrangements for monitoring and providing advisories to MWOs and aircraft operators of volcanic ash in the atmosphere. The advisories support the issuance of SIGMET on these events by the respective MWOs. The IAVW is based on the cooperation of aviation and non-aviation operational units using information derived from observing sources and networks that are provided by States for the detection of volcanic ash in the atmosphere. The forecasts issued by the nine designated VAACs are in plain language text and PNG chart form. The advisory information on volcanic ash is prepared by VAACs in accordance with Annex 3 (Chapter 3 and Appendix 2). ICAO administers the IAVW with the cooperation of the VAAC provider States and concerned international organizations through the International Airways Volcano Watch Operations Group (IAVWOPSG). Additionally, ICAO recognizes the importance of State volcano observatories as part of the world organization of volcano observatories in their role or providing information on the pre-eruption and eruption of volcanoes.

Element 3: Tropical cyclone watch

TCAC, per regional air navigation agreement, monitor the formation, movement and degradation of tropical cyclones. The forecasts issued by the TCACs are in plain language text and graphical form. The advisory information on tropical cyclones is prepared by TCACs in accordance with Annex 3 (Chapter 3 and Appendix 2). The advisories support the issuance of SIGMET on these events by the respective MWOs.

Element 4: Aerodrome warnings

Aerodrome warnings give concise information of meteorological conditions that could adversely affect aircraft on the ground, including parked aircraft, and the aerodrome facilities and services. Aerodrome warnings are issued in accordance with Annex 3 (Chapter 7 and Appendix 6) where required by operators or aerodrome services. Aerodrome warnings should relate to the occurrence or expected occurrence of one or more of the following phenomena: tropical cyclone, thunderstorm, hail, snow, freezing precipitation, hoar frost or rime, sandstorm, dust-storm, rising sand or dust, strong surface wind and gusts, squall, frost, volcanic ash, tsunami, volcanic ash deposition, toxic chemicals, and other phenomena as agreed locally. Aerodrome warnings are issued usually for validity periods of not more than 24 hours. Aerodrome warnings are disseminated within the aerodrome in accordance with local arrangements to those concerned, and should be cancelled when the conditions are no longer occurring and/or no longer expected to occur at the aerodrome.

Element 5: Wind shear warnings and alerts

Wind shear warnings are prepared for aerodromes where wind shear is considered a factor, issued in accordance with Annex 3 (Chapter 7 and Appendix 6) and disseminated within the aerodrome in accordance with local arrangements to those concerned. Wind shear conditions are normally associated with the following phenomena: thunderstorms, microbursts, funnel cloud (tornado or waterspout), and gust fronts, frontal surfaces, strong surface winds coupled with local topography; sea breeze fronts, mountain waves (including low-level rotors in the terminal area) and low-level temperature inversions.

At aerodromes where wind shear is detected by automated, ground-based, wind shear remote-sensing or detection equipment, wind shear alerts generated by these systems are issued (updated at least every minute). Wind shear alerts give concise, up-to-date information related to the observed existence of wind shear involving a headwind/tailwind change of 7.5 m/s (15 kt) or more which could adversely affect aircraft on the final approach path or initial take-off path and aircraft on the runway during the landing roll or take-off run.

In some instances, the systems used for the detection of wind shear have proven utility in wake turbulence detection and tracking/monitoring. This may prove especially beneficial for congested and/or complex aerodromes (e.g. close parallel runways) since ground-based LIDAR at an aerodrome can serve a dual purpose – i.e. wake vortices are an issue when wind shear is not.

Element 6: SIGMET

SIGMETs are information issued by each State‘s MWO for their respective FIR and/or CTA. SIGMETs are messages that describe the location of specified en-route weather phenomena which may affect the safety of aircraft operations. SIGMETs are typically issued for thunderstorms, turbulence, icing, mountain wave, volcanic ash, tropical cyclones and radiation.

Intended performance operational improvement/metric to determine success

Optimized usage of airspace capacity, thus achieving arrival and departure rates.

Reduction in costs through reduced arrival and departure delays (viz. reduced fuel burn).

Harmonized arriving air traffic (en-route to terminal area to aerodrome) and harmonized departing air traffic (aerodrome to terminal area to en-route) will translate to reduced arrival and departure holding times and thus reduced fuel burn.

Reduced fuel burn through optimized departure and arrival profiling/scheduling.

Supports pre-tactical and tactical arrival and departure sequencing and thus dynamic air traffic scheduling.

Gate-to-gate seamless operations through common access to, and use of, the available WAFS, IAVW and tropical cyclone watch forecast information.

Common understanding of operational constraints, capabilities and needs, based on expected (forecast) meteorological conditions.

Decreased variance between the predicted and actual air traffic schedule.

Increased situational awareness and improved consistent and collaborative decision-making.

Necessary procedures (air and ground)

No new procedures necessary.

Necessary system capability

Avionics

No new or additional avionics requirements and brought about by this module.

Ground systems

ANSPs, airport operators and airspace users may want to implement functionalities allowing them to display in plain text or graphical format the available meteorological information. For Block 0, airspace users may use their AOC data link connection to the aircraft to send the meteorological information where appropriate

Human factors considerations

General statements on the impact on operational functions.

This module will not necessitate significant changes in how air navigation service providers and users access and make use of the available meteorological information today.

Training and qualification requirements

No new or additional training and qualification requirements are brought about by this module.

Reference documents

- ICAO and Industry Standards (i.e. MOPS, MASPS, SPRs)
- ICAO and World Meteorological Organization (WMO) international standards for meteorological information (including, content, format, quantity, quality, timeliness and availability)

Module summary

<table>
<tr><td colspan="6"><u>Title of the Module:</u>
B0-105: Meteorological information supporting enhanced operational efficiency and safety</td></tr>
<tr><td colspan="2"><u>Elements:</u>
1. WAFS-IAVW-TCW
2. Aerodrome warning, wind shear warning and alerts
3. SIGMET information</td><td colspan="2"><u>Equipage/Air</u>
- Nil</td><td colspan="2"><u>Equipage/Ground</u>
- Connection to the AFS satellite and public Internet distribution systems
- Connection to the AFTN
- Local arrangements for reception of aerodrome warning ,wind shear warning and alerts</td></tr>
<tr><td colspan="6">Implementation monitoring and intended performance impact</td></tr>
<tr><td rowspan="2"><u>Implementation progress</u>
1 Indicator:
States implementation of SADIS 2G satellite broadcast and/or Secure SADIS FTP service.

2. Indicator:
States implementation of WAFS Internet File Service (WIFS)</td><td colspan="5">Qualitative performance benefits associated with five main KPAs only</td></tr>
<tr><td><u>KPA-Access/Equity</u>
Not Applicable</td><td><u>KPA-Capacity</u>
Optimized usage of airspace and aerodrome capacity due to MET support</td><td><u>KPA-Efficiency</u>
Reduced arrival/departure holding time, thus reduced fuel burn due to MET support</td><td><u>KPA-Environment</u>
Reduced emissions due to reduced fuel burn due to MET support</td><td><u>KPA-Safety</u>
Reduced incidents/accidents in flight and at international aerodromes due to MET support.</td></tr>
</table>

PERFORMANCE IMPROVEMENT AREA 3: OPTIMUM CAPACITY AND FLEXIBLE FLIGHTS – THROUGH GLOBAL COLLABORATIVE ATM

B0-10: Improved Operations through Enhanced En-Route Trajectories

Introduction

This module is applicable to en-route and terminal airspace. Benefits can start locally. The larger the size of the concerned airspace the greater the benefits, in particular for flex track aspects. Benefits accrue to individual flights and flows. This will allow greater routing possibilities, reducing potential congestion on trunk routes and busy crossing points, resulting in reduced flight length and fuel burn.

In many areas, flight routings offered by air traffic services (ATS) are static and are slow to keep pace with the rapid changes of users operational demands, especially for long-haul city-pairs. In certain parts of the world, legacy regional route structures have become outdated and are becoming constraining factors due to their inflexibility.

The navigational capabilities of modern aircraft make a compelling argument to migrate away from the fixed route structure towards a more flexible alternative. Constantly changing upper winds have a direct influence on fuel burn and, proportionately, on the carbon footprint. Therein lies the benefit of daily flexible routings. Using what is already available on the aircraft and within air traffic control (ATC) ground systems, the move from fixed to flex routes can be accomplished in a progressive, orderly and efficient manner.

Baseline

The baseline for this module is varying from a State/region to the next. However, while some aspects have already been the subject of local improvements, the baseline generally corresponds to an airspace organization and management function which is at least in part characterized by: individual State action, fixed route network, permanently segregated areas, conventional navigation or limited use of area navigation (RNAV), rigid allocation of airspace between civil and military authorities. Where it is the case, the integration of civil and military ATS has been a way to eliminate some of the issues, but not all.

In many areas, flight routings offered by air traffic services (ATS) are static and are slow to keep pace with the rapid changes of users operational demands, especially for long-haul city-pairs. In certain parts of the region, regional route structures have become outdated and are becoming constraining factors due to their inflexibility that affect inclusive other States.

Change brought by the module

This module is aimed at improving the profiles of flights in the en-route phase through the deployment and full application of procedures and functionalities on which solid experience is already available, but which have not been systematically exploited and which are of a nature to make better use of the airspace.

The module is the opportunity to exploit performance-based navigation (PBN) capabilities in order to eliminate design constraints and operate more flexibly, while facilitating the overall handling of traffic flows.

The module is made of the following elements:

a) airspace planning: possibility to plan, coordinate and inform on the use of airspace. This includes collaborative decision-making (CDM) applications for en-route airspace to anticipate on the knowledge of the airspace use requests, take into account preferences and inform on constraints;
b) flexible use of airspace (FUA) to allow both the use of airspace otherwise segregated, and the reservation of suitable volumes for special usage; this includes the definition of conditional routes; and
c) f lexible routing (flex tracking): route configurations designed for specific traffic pattern. This module is a first step towards more optimized organization and management of the airspace but which would require more sophisticated assistance. Initial implementation of PBN, RNAV for example, takes advantage of existing ground technology and avionics and allows extended collaboration of air navigation service providers (ANSPs) with partners: military, airspace users, neighboring States.

Element 1: Airspace planning

Airspace planning entails activities to organize and manage airspace prior to the time of flight. Here it more specifically refers to activities to improve the strategic design by a series of measures to better know the anticipated use of the airspace and adjust the strategic design by pre-tactical or tactical actions.

Element 2: Flexible use of airspace (FUA)

Flexible use of airspace is an airspace management concept according to which airspace should not be designated as either purely civil or purely military airspace, but should be considered as one continuum in which all users‘ requirements have to be accommodated to the maximum extent possible. There are activities which require the reservation of a volume of airspace for their exclusive or specific use for determined periods, owing to the characteristics of their flight profile or their hazardous attributes and the need to ensure effective and safe separation from non-participating air traffic. Effective and harmonized application of FUA needs clear and consistent rules for civil/military coordination which should take into account all users‘requirements and the nature of their various activities. Efficient civil/military coordination procedures should rely on rules and standards to ensure efficient use of airspace by all users. It is essential to further cooperation between neighboring States and to take into account cross border operations when applying the concept of FUA.

Where various aviation activities occur in the same airspace but meet different requirements, their coordination should seek both the safe conduct of flights and the optimum use of available airspace.
Accuracy of information on airspace status and on specific air traffic situations and timely distribution of this information to civil and military controllers has a direct impact on the safety and efficiency of operations.

Timely access to up-to-date information on airspace status is essential for all parties wishing to take advantage of airspace structures made available when filing or re-filing their flight plans.

The regular assessment of airspace use is an important way of increasing confidence between civil and military service providers and users and is an essential tool for improving airspace design and airspace management.

FUA should be governed by the following principles:

a) coordination between civil and military authorities should be organized at the strategic, pre-tactical and tactical levels of airspace management through the establishment of agreements and procedures in order to increase safety and airspace capacity, and to improve the efficiency and flexibility of aircraft operations;
b) consistency between airspace management, air traffic flow management and air traffic services should be established and maintained at the three levels of airspace management in order to ensure, for the benefit of all users, efficiency in airspace planning, allocation and use;
c) the airspace reservation for exclusive or specific use of categories of users should be of a temporary nature, applied only during limited periods of time-based on actual use and released as soon as the activity having caused its establishment ceases;
d) States should develop cooperation for the efficient and consistent application of the concept of FUA across national borders and/or the boundaries of flight information regions, and should in particular address cross-border activities; this cooperation shall cover all relevant legal, operational and technical issues; and
e) ATS units and users should make the best use of the available airspace.

Element 3: Flexible routing

Flexible routing is a design of routes (or tracks) designed to match the traffic pattern and other variable factors such as meteorological conditions. The concept, used over the North-Atlantic since decades can be expanded to address seasonal or week end flows, accommodate special events, and in general better fit the meteorological conditions, by offering a set of routes which provide routings closer to the user preferences for the traffic flows under consideration.

When already in place, flex tracks systems can be improved in line with the new capabilities of ATM and aircraft, such as PBN and automatic dependent surveillance (ADS).

Convective meteorological conditions, particularly deep convection associated with towering cumulus and/or cumulonimbus clouds, causes many delays in today‘s system due to their hazardous nature (severe icing, severe turbulence, hail, thunderstorms, etc.), often-localized nature and the labor intensive voice exchanges of complex reroutes during the flight. New data communications automation will enable significantly faster and more efficient delivery of reroutes around such convective activity. This operational improvement will expedite clearance delivery resulting in reduced delays and miles flown during convective meteorological conditions.

Intended Performance Operational Improvement

Metrics to determine the success of the module are proposed in the Manual on Global Performance of the Air Navigation System (Doc 9883).

This module support a better access to airspace by a reduction of the permanently segregated volumes.

In terms of capacity the availability of a greater set of routing possibilities allows reducing potential congestion on trunk routes and at busy crossing points. The flexible use of airspace gives greater possibilities to separate flights horizontally. PBN helps to reduce route spacing and aircraft separations. This in turn allows reducing controller workload by flight.

The different elements concur to trajectories closer to the individual optimum by reducing constraints imposed by permanent design. In particular the module will reduce flight length and related fuel burn and emissions. The potential savings are a significant proportion of the ATM related inefficiencies. The module will reduce the number of flight diversions and cancellations. It will also better allow avoiding noise sensitive areas.

Some of the benefits include: reduced flight operating costs, reduced fuel consumption, more efficient use of airspace (access to airspace outside of fixed airway structure), reduced carbon footprint, and reduced controller workload.

Necessary procedures (air and ground)

Required procedures exist for the main. They may need to be complemented by local practical guidance and processes; however, the experience from other regions can be a useful reference source to be customized to the local conditions.

The development of new and/or revised ATM procedures is automatically covered by the definition and development of listed elements. However, given the interdependencies between some of the modules, care needs to be taken so that the development of the required ATM procedures provides for a consistent and seamless process across these modules.

The airspace requirements (RNAV, RNP and the value of the performance required) may require new ATS procedures and ground system functionalities. Some of the ATS procedures required for this module are linked with the processes of notification, coordination and transfer of control, supported by messages exchange (Module B0-25).

Element 1: Airspace planning

See general remarks above.

Element 2: FUA

The ICAO Civil/Military Cooperation in Air Traffic Management (Cir 330) offers guidance and examples of successful practices of civil and military cooperation. It realizes that successful cooperation requires collaboration that is based on communication, education, a shared relationship and trust.

FUA regional guidance developed for SAM Region.

Element 3: Flexible routing

A number of operational issues and requirements will need to be addressed to enable harmonized deployment of flex route operations in a given area such as:

a) some adaptation of letters of agreement;

b) revised procedures to consider the possibility of transfer of control at other than published fixes;
c) use of latitude/longitude or bearing and distance from published fixes, as sector or flight information region (FIR) boundary crossing points;
d) review of controller manuals and current operating practices to determine what changes to existing practices will need to be developed to accommodate the different flows of traffic which would be introduced in a flex route environment;
e) specific communication and navigation requirements for participating aircraft will need to be identified;

f) developing procedures that will assist ATC in applying separation minima between flights on the fixed airway structure and flex routes both in the strategic and tactical phases;
g) procedure to cover the transition between the fixed network and the flex route airspace both horizontally and vertically. In some cases, a limited time application (e.g. during night) of flex route operations could be envisaged. This will require modification of ATM procedures to reflect the night traffic patterns and to enable the transition between night flex route operations and daytime fixed airway operations; and
h) training package for ATC.

Necessary system capability

Avionics

Deployment of PBN is ongoing. The benefits provided to flights can facilitate its dissemination, but it will remain linked to how aircraft can fly.

Dynamic re-routing can require aircraft connectivity (Aircraft communication addressing and reporting system (ACARS)) to its flight operating center for flight tracking and the up-load of new routes computed by the FOC flight planning system (FPS), and possibly FANS 1/A capability for the exchange of clearance with ATC.

Ground systems

Technology is available. Even CDM can be supported by a form of internet portal. However, since aviation operations are global, standardization of the information and its presentation will be increasingly required (see thread 30 on SWIM).

Basic FUA concept can be implemented with the existing technology. Nevertheless for a more advanced use of conditional routes, a robust collaborative decision system will be required including function for the processing and display of flexible or direct routes containing latitude/longitude. In addition to published fixes a coordination function is also needed and may need specific adaptations to support transfer of control over non published points.

Enhanced FPS today are predicated on the determination of the most efficient flight profile. The calculations of these profiles can be driven by cost, fuel, time, or even a combination of the factors. All airlines deploy FPS at different levels of sophistication and automation in order to assist flight dispatchers/planners to verify, calculate and file flight plans.

Additionally, the flight dispatcher would need to ensure the applicability of over-flight permissions for the over-flown countries. Regardless of the route calculated, due diligence must always be exercised by the airline in ensuring that NOTAMs and any restrictive flight conditions will always be checked and validated before a flight plan is filed. Further, most airlines are required to ensure a flight following or monitoring program to update the crews with any changes in the flight planning assumptions that might have changed since the first calculation was made.

Human factors considerations

The roles and responsibilities of controller/pilot are not affected. However, human factors have been taken into consideration during the development of the processes and procedures associated with this module. Where automation is to be used, the human-machine interface has been considered from both a functional and ergonomic perspective. The possibility of latent failures however, continues to exist and vigilance is requested during all implementation actions. It is further requested that human factor issues, identified during implementation, be reported to the international community through ICAO as part of any safety reporting initiative.

Training and qualification requirements

The required training is available and the change step is achievable from a human factors perspective. Training in the operational standards and procedures are required for this module. Likewise, the qualifications requirements are identified in the regulatory requirements which form an integral part to the implementation of this module.

Regulatory/standardization needs and approval plan (air and ground)

Regulatory/standardization: use current published requirements.

Approval plans: to be determined, based upon regional applications.

Element 1: Airspace planning

See general remarks above.

Element 2: FUA

Until today, the Article 3 of the Chicago Convention expressly excludes the consideration of State aircraft from the scope of applicability.

Exemption policies for specific State aircraft operations and services are currently used as a method to cope with the discrepancy of civil and military aviation needs. Some States already realize that for State aircraft a solution lays in an optimum compatibility to civil aviation, although military requirements have to be met.

ICAO provisions related to coordination between civil and military in support to the flexile use of airspace can be found in several annexes, PANS and manuals.

Annex 11 — Air Traffic Services allows States to delegate responsibility for the provision of ATS to another State. However, States retain sovereignty over the airspace so delegated, as confirmed by their adherence to the Chicago Convention. This factor may require additional effort or coordination in relation to civil/military cooperation and an appropriate consideration in bilateral or multilateral agreements.

Element 3: Flexible routing

LoA: Letters of agreement (LoA) might be revised to reflect the specificities of flex route operations. Local hand-off procedures, timings and frequency allocations must be clearly detailed. Allocation schemes are also useful in designing major unidirectional flows, such as the EUR-Caribbean flows.

Common enabler: PBN procedures

Within an airspace concept, PBN requirements will be affected by the communication, surveillance and ATM environments, the navaid infrastructure, and the functional and operational capabilities needed to meet the ATM application. PBN requirements also depend on what reversionary, non-RNAV means of navigation are available and what degree of redundancy is required to ensure adequate continuity of functions.

The selection of the PBN specification(s) for a specific area or type of operation has to be decided in consultation with the airspace users. Some areas need only a simple RNAV to maximize the benefits, while other areas such as nearby steep terrain or dense air traffic may require the most stringent RNP. International public standards for PBN are still evolving. International PBN is not widespread. According to the ICAO/IATA Global PBN Task Force, international air traffic management and state flight standards rules and regulations lag behind airborne capability.

There is a need for worldwide harmonization of RNP requirements, standards, procedures and practices, and common flight management system functionality for predictable and repeatable RNP procedures, such as fixed radius transitions, radius-to-fix legs, required time of arrival (RTA), parallel offset, VNAV, 4D control, ADS-B, data link, etc.

A safety risk management document may be required for every new or amended procedure. That requirement will extend the time required to implement new procedures, especially PBN-based flight procedures.

Reference documents and guidance material

- ICAO Doc 4444, Procedures for Air Navigation Services -Air Traffic Management, Chapter 5
- ICAO Doc 9426, Air Traffic Services Planning Manual
- ICAO Doc 9554, Manual Concerning Safety Measures Relating to Military Activities Potentially Hazardous to Civil Aircraft Operations
- ICAO Doc 9613, Performance-based Navigation (PBN) Manual
- ICAO Doc 9689, Manual on Airspace Planning Methodology for the Determination of Separation Minima
- ICAO CDM and ATFM (under development) Manual
- ICAO Doc 9554, Manual Concerning Safety Measures Relating to Military Activities Potentially Hazardous to Civil Aircraft Operations
- ICAO Circular 330 AN/189, Civil/Military Cooperation in Air Traffic Management

Module summary

Title of the Module: **B0-10: Improved Operations through Enhanced En-Route Trajectories**					
Elements: 1. Airspace planning 2. Flexible Use of airspace 3. Flexible Routing		Equipage/Air - FANS 1/A and ACARS		Equipage/Ground - CDM through Internet portal	
Implementation monitoring and intended performance impact					
Implementation progress	Qualitative performance benefits associated with five main KPAs only				
1. Indicator: *Percentage of time segregated airspaces are available for civil operations in the State* 2. Indicator: *Percentage of PBN routes implemented*	KPA-Access/Equity Better access to airspace by a reduction of the permanently segregated volumes of airspace.	KPA-Capacity Flexible routing reduces potential congestion on trunk routes and at busy crossing points. The flexible use of airspace gives greater possibilities to separate flights horizontally. PBN helps to reduce route spacing and aircraft separations.	KPA-Efficiency In particular the module will reduce flight length and related fuel burn and emissions. The module will reduce the number of flight diversions and cancellations. It will also better allow avoiding noise sensitive areas.	KPA-Environment Fuel burn and emissions will be reduced.	KPA-Safety Not Applicable

B0-35: Improved Flow Performance through Planning based on a Network-Wide view

General

The techniques and procedures brought by this module capture the experience and state-of-the-art of the current air traffic flow management (ATFM) systems in place in some regions, and which have developed as they were facing demand-capacity imbalances. Global ATFM seminars and bi-lateral contacts have allowed the dissemination of good practices.

Experience clearly shows the benefits related to managing flows consistently and collaboratively over an area of a sufficient geographical size to take into account sufficiently well the network effects. The concept for ATFM and demand and capacity balancing (DCB) should be further exploited wherever possible. System improvements are also about better procedures in these domains, and creating instruments to allow collaboration among the different actors.

Overall, to meet the objectives of balancing demand and capacity, keeping delays to a minimum and avoiding congestion, bottlenecks and overload, ATFM undertakes flow management in three broad phases. Each flight will usually have been subjected to these phases, prior to being handled operationally by ATC.

Strategic ATFM activity takes place during the period from several months until a few days before a flight. During this phase, comparison is made between the expected air traffic demand and the potential ATC capacity. Objectives are set for each ATC unit in order for them to provide the required capacity. These objectives are monthly reviewed in order to minimize the impact of the missing capacity on the airspace users. In parallel, an assessment of the number and routings of flights, which aircraft operators are planning, enables ATFM to prepare a routing scheme, balancing the air traffic flows in order to ensure maximum use of the airspace and minimize delays.

Pre-tactical ATFM is action taken during the few days before the day of operation. Based on the traffic forecasts, the information received from every ATC center covered by the ATFM service, statistical and historical data, the ATFM notification message (ANM) for the next day is prepared and agreed through a collaborative process. The ANM defines the tactical plan for the next (operational) day and informs aircraft operators (AOs) and ATC units about the ATFM measures that will be in force on the following day. The purpose of these measures is not to restrict but to manage the flow of traffic in a way that minimizes delay and maximizes the use of the entire airspace.

Tactical ATFM is the work carried out on the current operational day. Flights taking place on that day receive the benefit of ATFM, which includes the allocation of individual aircraft departure times, re-routings to avoid bottlenecks and alternative flight profiles to maximize efficiency.

ATFM has also progressively been used to address system disruptions and evolves into the notion of management of the performance of the Network under its jurisdiction, including management of crises provoked by human or natural phenomena.

Baseline

The need for ATFM has emerged as traffic densities increased, and it took form progressively. It is observed that this need is now spreading progressively over all continents, and that even where overall capacity is not an issue, the efficient management of flows through a given volume of airspace deserves a specific consideration at a scale beyond that of a sector or an ACC, in order to better plan resources, anticipate on issues and prevent undesired situations.

Change brought by the module

ATFM has developed progressively over the last thirty years. It is noticeable that key steps have been necessary to be able to predict traffic loads for the next day with a good accuracy, to move from measures defined as rate of entry into a given piece of airspace (and not as departure slots) to measures implemented before take-off and taking into account the flows/capacities in a wider area.

More recently the importance of proposing alternative routings rather than only a delay diagnosis has been recognized, thereby also preventing over-reservations of capacity. ATFM services offer a range of web-based or business to business services to ATC, airports and aircraft operators, actually implementing a number of CDM applications.

In order to regulate flows, ATFM may take measures of the following nature:

a) departure slots ensuring that a flight will be able to pass the sectors along its path without generating overflows;
b) rate of entry into a given piece of airspace for traffic along a certain axis;
c) requested time at a way-point or an FIR/sector boundary along the flight;
d) miles-in-trail figures to smooth flows along a certain traffic axis;
e) re-routing of traffic to avoid saturated areas;
f) sequencing of flights on the ground by applying departure time intervals (MDI);
g) level capping; and
h) delaying of specific flights on the ground by a few minutes ("take-off not before").

Intended performance operational improvement

Metrics to determine the success of the module are proposed in the *Manual on Global performance of the Air Navigation System* (Doc 9883).

This module improved access by avoiding disruption of air traffic in periods of demand higher than capacity and ATFM processes take care of equitable distribution of delays.

It provides a better utilization of available capacity, network-wide; in particular the trust of ATC not being faced by surprise to saturation tends to let it declare/use increased capacity levels; ability to anticipate difficult situations and mitigate them in advance.

Reduced fuel burn due to better anticipation of flow issues; a positive effect to reduce the impact of inefficiencies in the ATM system or to dimension it at a size that would not always justify its costs (balance between cost of delays and cost of unused capacity). It also reduces block times and times with engines on.

The reduced fuel burn as delays are absorbed on the ground, and the predictability of schedules as the ATFM algorithms tends to limit the number of large delays impact positively in environment.

The reduced occurrences of undesired sector overloads improve safety.

The business case has proven to be positive due to the benefits that flights can obtain in terms of delay reduction.

Necessary procedures (air and ground)

An ICAO guidance material on ATFM is being developed and need to be completed and approved. US/Europe experience is enough to help initiate application in other regions.

New procedures are required to link much closer the ATFM with ATS in the case of using miles-in-trail or Arrival management or Departure management (see Module B0-15).

Necessary system capability

Avionics

No avionics requirements.

Ground systems

When serving several FIRs, ATFM systems are generally deployed as a specific unit, system and software connected to the ATC units and airspace users to which it provides its services. Regional ATFM units have been the subject of specific developments. The main functions for ATFM systems are: demand and capacity balancing, performance measurements and monitoring, network operations plan management and traffic demand management.

Human factors considerations

Controllers are protected from overloads and have a better prediction of their workload. ATFM does not interfere in real-time with their ATC tasks. However, human factors have been taken into consideration during the development of the processes and procedures associated with this module. Where automation is to be used, the human-machine interface has been considered from both a functional and ergonomic perspective (See Section 6 for examples). The possibility of latent failures however, continues to exist and vigilance is requested during all implementation actions. It is further requested that human factor issues, identified during implementation, be reported to the international community through ICAO as part of any safety reporting initiative.

Training and qualification requirements

Flow managers in the flow management unit and controllers in area control centres (ACCs) using the remote flow management information or applications needs specific training and airline dispatchers using the remote flow management information or applications need training.

Training in the operational standards and procedures are required for this module and can be found in the links to the documents in Section 8 to this module. Likewise, the qualifications requirements are identified in the regulatory requirements in Section 6 which form an integral part to the implementation of this module.

Regulatory/standardization needs and approval plan (air and ground)

Regulatory/standardization: new standards and requirements is required for standard ATFM messages.

Approval plans: to be determined.

Reference documents and guidance material

- CAR/SAM ATFM and CDM Manual.
- ICAO CDM and ATFM (under development) Manual.

Module summary

Title of the Module: **B0-35: Improved Flow Performance through Planning based on a Network-Wide view**					
Elements: Air Traffic Flow Management		Equipage/Air - Nil		Equipage/Ground - System software for ATFM	
Implementation monitoring and intended performance impact					
Implementation progress 1. Indicator: *Percentage of ATS units using ATFM services.*	Qualitative performance benefits associated with five main KPAs only				
	KPA-Access/Equity Improved Access and equity in the use of airspace or aerodrome by avoiding disruption of air traffic. ATFM processes take care of equitable distribution of delays.	KPA-Capacity Better utilization of available capacity, ability to anticipate difficult situations and mitigate them in advance.	KPA-Efficiency Reduced fuel burn due to better anticipation of flow issues; Reduced block times and times with engines on.	KPA-Environment Reduced fuel burn as delays are absorbed on the ground, with shut engines; or at optimum flight levels through speed or route management..	KPA-Safety Reduced occurrences of undesired sector overloads

B0-84: Initial capability for ground surveillance

General

The surveillance service delivered to users may be based on a mix of three main types of surveillance as defined in the ICAO *Aeronautical Surveillance Manual* (Doc 9924):

a) independent non-cooperative surveillance: The aircraft position is derived from measurement not using the cooperation of the remote aircraft;
b) independent cooperative surveillance: The position is derived from measurements performed by a local surveillance subsystem using aircraft transmissions. Aircraft-derived information (e.g. pressure altitude, aircraft identity) can be provided from those transmissions; and
c) dependent cooperative surveillance: The position is derived on board the aircraft and is provided to the local surveillance subsystem along with possible additional data (e.g. aircraft identity, pressure altitude). 1.1.2 The module describes the dependent/cooperative and independent/cooperative surveillance services.

Baseline

Currently, air to ground aircraft position and surveillance is accomplished through the use of primary, secondary radar surveillance, voice position report, ADS-C and CPDLC, etc. The primary surveillance radar derives aircraft position based on radar echo returns. The secondary radar is used to transmit and receive aircraft data for barometric altitude, identification code. However, current primary and secondary radars cannot be easily sited in oceanic locations, or rough terrain such as in mountainous regions, and have a heavy reliance on mechanical components with large maintenance requirements.

Change brought by the module

This module introduces the opportunity to expand ATC radar equivalent service with two new surveillance techniques that can be used, separately or jointly: ADS-B and MLAT. These techniques provide alternatives to classic radar technology at a lower implementation and maintenance cost, thereby allowing the provision of surveillance services in areas where they are currently not available for geographical or cost reasons. These techniques also allow, in certain conditions, a reduction of separation minima thereby potentially increasing the ability to accommodate larger volumes of traffic.

Element 1: ADS-B

Dependent surveillance with accurate position sources such ADS-B is recognized as one of the important enablers of several of the ATM operational concept components including traffic synchronization and conflict management (Recommendation 1/7, AN-Conf/11, 2003). The transmission of ADS-B information (ADS-B OUT) is already used for surveillance in some non-radar areas (Block 0).

Dependent surveillance is an advanced surveillance technology that allows avionics to broadcast an aircraft’s identification, position, altitude, velocity, and other information. The broadcast aircraft position is more accurate than with conventional secondary surveillance radar (SSR) because it is normally based on the global navigation satellite system (GNSS) and transmitted at least once per second. The inherent accuracy of the GPS determined position and the high update rate will provide service providers and users improvements in safety, capacity, and efficiency.

Note.– ADS-B is dependent upon having a source of required positional accuracy (such as global navigation satellite system (GNSS) today).

Operationally, the lower costs of dependent surveillance ground infrastructure in comparison to conventional radars support business decisions to expand radar equivalent service volumes and the use of radar-like separation procedures into remote or non-radar areas. In addition to lower costs, the non-mechanical nature of the ADS-B ground infrastructure allows it to be sited in locations that are difficult for radar installations.

Use of dependent surveillance also improves the search and rescue support provided by the surveillance network. In non-radar areas, ADS-B’s positional accuracy and update rate allows for improved flown trajectory tracking allowing for early determination of loss of contact and enhances the ability for search and rescue teams to pinpoint the related location.

Additionally, dependent surveillance information can be an enabler for sharing of surveillance data across FIR boundaries and significantly improves the performance of predictive tools using aircraft derived velocity vector and vertical rate data. This is particularly useful to support safety net tools. It also downlinks other useful ATC relevant data similar to Mode S DAPS.

ADS-B OUT Standards and Recommended Practices (SARPs) (ICAO Annex 10 — *Aeronautical Telecommunications* , Volume IV — S*urveillance and Collision Avoidance Systems* and the *Manual on Technical Provisions for Mode S Services and Extended Squitter* (Doc 9871)) and MOPS (RTCA-DO260-B/Eurocae ED102-A) are available. AN-Conf/11 recommended ADS-B on 1090MHz for international use and this is happening. Equipage rate is growing together with Mode S, airborne collision avoidance system (ACAS) and ADS-B OUT mandates. ADS-B OUT, Version 2 also provides for ACAS RA DOWNLINK information in support of monitoring activities currently only possible in secondary surveillance radar (SSR) Mode S coverage.

Element 2: Multilateration (MLAT)

MLAT technique is a new technique providing independent cooperative surveillance. Its deployment is made easier by the use of airborne mode S equipment capability with the spontaneous transmission of messages (squitters). In this case the signal transmitted by aircraft is received by a network of receivers located at different places. The use of the different times of arrival at the different receivers allows an independent determination of the position of the source of signals. In theory this technique can be passive and use the existing transmissions made by the aircraft or be active and trigger replies in the manner of Mode S SSR interrogations. Conventional Mode A/C transponders respond when they are interrogated.

MLAT systems were initially deployed on main airports to make the surveillance of aircraft on the surface. The technique is now used to provide surveillance over wide area (wide area MLAT system - WAM). MLAT requires more ground stations than ADS-B and reliable linked network and has large geometric requirements than ADS-B, but has the early implementation advantage of using current Mode A/C aircraft equipage.

Intended performance operational improvement/metric to determine success

This module contributes to Safety reducing the number of major incidents and support to search and rescue services. It also contributes to the capacity in areas of traffic density compared to procedural minima.

Improved coverage, capacity, velocity vector performance and accuracy can improve ATC performance in both radar and non radar environments. Terminal area surveillance performance improvements are achieved through high accuracy, better velocity vector and improved coverage.

Comparison between procedural minima and 5 NM separation minima would allow an increase of traffic density in a given airspace; or comparison between installing/renewing SSR Mode S stations using Mode S transponders and installing ADS-B OUT (and/or MLAT systems) could be used in cost benefit analysis.

Necessary procedures (air and ground)

The relevant *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444) provisions are available.

Necessary system capability

Avionics

For ADS-B surveillance services, aircraft must be equipped with ADS-B OUT. Accuracy and integrity are reported from the avionics. Users of the data decide on the required accuracy and integrity for the application.

For MLAT, aircraft need to be equipped with Mode S radar transponders.

Ground systems

Units providing surveillance services must be equipped with a ground-based surveillance data processing system able to process and display the aircraft positions. Connection to a flight data processing system allows positive identification by correlating positions and flight data.

Units may provide ADS-B surveillance in environments where there is full or partial avionics equipage depending on the capabilities and procedures of the air traffic control (ATC) system.

ATC systems must also be designed to enable the delivery of separation services between ADS-B-to-ADS-B and ADS-B-to-radar and fused targets.

Human factors considerations

The air traffic controller has a direct representation of the traffic situation, and reduces the task of controllers or radio operators to collate position reports.

Training and qualification requirements

Controllers must receive specific training for separation provision, information service and search and rescue based on the ADS-B and WAM systems in use.

Training in the operational standards and procedures are required for this module. Likewise, the qualifications requirements are identified in the regulatory requirements.

Reference documents and guidance material

- ICAO Annex 10 — *Aeronautical Telecommunications*, Volume IV □*Aeronautical Radio*
- *Frequency Spectrum Utilization*
- ICAO Doc 9828, *Report of the Eleventh Air Navigation Conference (2003)*
- ICAO Doc 9871, *Technical Provisions for Mode S Services and Extended Squitter*
- RTCA MOPS DO260 and DO260A EUROCAE ED102 and ED102A.
- ICAO Doc 4444, *Procedures for Air Navigation Services — Air Traffic Management*
- ICAO Doc 9924, *Aeronautical Surveillance Manual*
- ICAO *Assessment of ADS-B and Multilateration Surveillance to Support Air Traffic Services and Guidelines for Implementation* (Circular 326)
- ICAO Asia Pacific: ADS-B Implementation and Operations Guidance Document.

Module summary

<table>
<tr><td colspan="6"><u>Title of the Module:</u>
B0-84: Initial capability for ground surveillance</td></tr>
<tr><td colspan="2"><u>Elements:</u>
1. ADS-B
2. Multilateration</td><td colspan="2"><u>Equipage/Air</u>
- ADS-B OUT.
- Mode S radar transponders for Multilateration</td><td colspan="2"><u>Equipage/Ground</u>
- FDPS and SDPS
- ADS-B
- Multilateration</td></tr>
<tr><td colspan="6">Implementation monitoring and intended performance impact</td></tr>
<tr><td rowspan="2"><u>Implementation progress</u>
1. Indicator: Percentage of international aerodromes with ADS-B/MLAT</td><td colspan="5">Qualitative performance benefits associated with five main KPAs only</td></tr>
<tr><td><u>KPA-Access/Equity</u>
Not Applicable</td><td><u>KPA-Capacity</u>
Typical separation minima are 3 NM or 5 NM enabling an increase in traffic density compared to procedural minima.
TMA surveillance performance improvements are achieved through high accuracy, better velocity vector and improved coverage.</td><td><u>KPA-Efficiency</u>
Not Applicable</td><td><u>KPA-Environment</u>
Not Applicable</td><td><u>KPA-Safety</u>
Reduction of the number of major incidents.
Support to search and rescue.</td></tr>
</table>

B0-101 ACAS improvement

General

This module is dealing with the short term improvements to the performance of the existing airborne collision avoidance system (ACAS). ACAS is the last resort safety net for pilots. Although ACAS is independent from the means of separation provision, ACAS is part of the ATM system.

Baseline

ACAS is subject to global mandatory carriage for airplanes with a MTCM greater than 5.7 tons. The current version of ACAS II is 7.0.

Change brought by the module

This module implements several optional improvements to airborne collision avoidance system in order to minimize "nuisance alerts" while maintaining existing levels of safety. The traffic alert and collision avoidance system (TCAS) version 7.1 introduces significant safety and operational benefits for ACAS operations.

Safety studies indicate that ACAS II reduces risk of mid-air collisions by 75% – 95% in encounters with aircraft that are equipped with either a transponder (only) or ACAS II respectively. ACAS II Standards and Recommended Practices (SARPs) are aligned with RTCA/EUROCAE MOPS.The SARPs and the MOPS have been upgraded in 2009/2010 to resolve safety issues and to improve operational performance. The RTCA DO185B and EUROCAE ED143 include these improvements also known as TCAS, v7.1.

The TCAS, v7.1 introduces new features namely the monitoring of own aircraft's vertical rate during a resolution advisory (RA) and a change in the RA annunciation from "Adjust Vertical Speed,Adjust" to "Level Off". It was confirmed that the new version of the CAS logic would definitely bring significant safety benefits, though only if the majority of aircraft in any given airspace are properly equipped. ICAO agreed to mandate the improved ACAS (TCAS, v7.1) for new installations as of 1/1/2014 and for all installations no later than 1/1/2017.

During a TCAS encounter, prompt and correct response to RAs is the key to achieve maximum safety benefits. Operational monitoring shows that pilots do not always follow their RA accurately (or do not follow at all). Roughly 20% of RAs in Europe are not followed.

TCAS safety and operational performance highly depends on the airspace in which it operates. Operational monitoring of TCAS shows that unnecessary RAs can occur when aircraft approach their cleared flight level separated by 1 000 ft with a high vertical rate. Roughly 50% of all RAs in Europe are issued in 1000 ft level-off geometries. AN-Conf/11 recognized the issue and requested to investigate automatic means to improve ATM compatibility.

In addition, two optional features can enhance ACAS performance:

a) coupling TCAS and auto-pilot/flight director to ensure accurate responses to RAs either automatically or manually thanks to flight director (APFD function); and
b) introduce a new altitude capture law to improve TCAS compatibility with ATM (TCAP function).

Intended Performance Operational Improvement

Metrics to determine the success of the module are proposed in the *Manual on Global Performance of the Air Navigation System* (Doc 9883).

Efficiency ACAS improvement will reduce unnecessary resolution advisory (RA) and then reduce trajectory deviations.
Safety ACAS increases safety in the case of breakdown of separation.
Cost Benefit Analysis TBD

Necessary Procedures (Air and Ground)

ACAS procedures are defined in PANS-ATM, Doc 4444 and in PANS-OPS, Doc 8168.
This evolution does not change procedures.

Necessary System Capability

Avionics

- RTCA DO185B / EUROCAE DO143 MOPS are available for TCAS implementation.
- RTCA DO325 Annex C is being modified to accommodate the 2 functions (APFD and TCAP).

Human Performance

Human factors considerations

ACAS performance is influenced by human behaviour. ACAS is a last resort function implemented on aircraft with a flight crew of two pilots. The operational procedures (PANS-OPS and PANS-ATM) have been developed and refined for qualified flight crews. Airbus has been able to certify the APFD function, which includes human factors aspects, on A380.

Human factors have been taken into consideration during the development of the processes and procedures associated with this module. Where automation is to be used, the human machine interface has been considered from both a functional and ergonomic perspective (See Section 6 for examples). The possibility of latent failures however, continues to exist and vigilance is required during all implementation activity. It is further requested that human factor issues identified during implementation, be reported to the international community through ICAO as part of any safety reporting initiative.

Training and qualification requirements

Training in the operational standards and procedures are required for this module and can be found in the links to the documents in Section 8 to this module. Likewise, the qualifications requirements are identified in the regulatory requirements in Section 6 which are integral to the implementation of this module. Training guidelines are described in the *Airborne Collision Avoidance System (ACAS) Manual* (Doc 9863). Recurrent training is recommended.

Regulatory/standardization needs and Approval Plan (Air and Ground)

Regulatory/standardization: use current published requirements that include the material given in Section 8.4. Approval plans: must be in accordance with application requirements e.g. EASA NPA 2010-03 requirement of 1/3/2012 for new installations and 1/12/2015 for all installations, or ICAO mandate of 1/1/2014 for new installations and 1/1/2017 for all installations.

Reference Documents

Standards

- ICAO Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport Aeroplanes*
- *ICAO* Annex 10 — *Aeronautical Telecommunications*, Volume IV - *Surveillance Radar and Collision Avoidance Systems* (Including Amendment 85- July 2010)
- EUROCAE ED-143/RTCA DO-185B, Minimum Operational Performance Standards for Traffic Alert and Collision Avoidance System II (TCAS II)
- RTCA DO-325, Minimum Operational Performance Standards (MOPS) for Automatic Flight
- Guidance and Control Systems and Equipment. Appendix C estimated 2013
- RTCA DO185B/EUROCAE DO143 MOPS for TCAS implementation

Procedures

- ICAO Doc 4444, *Procedures for Air Navigation Services - Air Traffic Management*
- ICAO Doc 8168, *Procedures for Air Navigation Services — Aircraft Operations*, Volume I — *Flight*.

Guidance material

- ICAO Doc 9863, *Airborne Collision Avoidance System (ACAS) Manual*

Approval documents

- FAA TSO-C119c.
- EASA ETSO-C119c.
- FAA AC120-55C.
- FAA AC20-151a.
- RTCA DO-185B, MOPS for TCAS II
- RTCA DO-325, Appendix C, for APFD and TCAP
- EUROCAE ED-143, MOPS for TCAS II

Title of the Module: **B0-101: ACAS Improvements**					
Elements: ACAS II (TCAS version 7.1)		Equipage/Air - TCAS V7.1		Equipage/Ground Nil	
Implementation monitoring and intended performance impact					
Implementation progress	Qualitative performance benefits associated with five main KPAs only				
1. Indicator: *Percentage of aircraft with ACAS, logic Version 7.1*	KPA-Access/Equity Not Applicable	KPA-Capacity Not Applicable	KPA-Efficiency ACAS improvement will reduce unnecessary resolution advisory (RA) and then reduce trajectory deviations.	KPA-Environment Not Applicable	KPA-Safety ACAS increases safety in the case of breakdown of separation.

B0-102: Increased Effectiveness of Ground-Based Safety Nets

General

This module aims to implement a baseline set of ground-based safety nets. Ground-based safety nets are intended to assist the air traffic controller in generating, in a timely manner, alerts of an increased risk to flight safety (collision, unauthorized airspace penetration and controlled flight into terrain), which may include resolution advice.

Change brought by the module

Ground-based safety nets are functionalities of ATM systems that have the sole purpose of monitoring the environment of operations, during airborne phases of flight, in order to provide timely alerts of an increased risk to flight safety. Ground-based safety nets make an essential contribution to safety and remain required as long as the operational concept remains human centered.

Ground-based safety nets have been in use since the 1980s. Provisions for ground-based safety nets were introduced in PANS-ATM, Doc 4444 in the early 2000s. This module corresponds to a baseline version of the safety nets as already implemented or being implemented in many areas.

This element is intended to assist the controller, in preventing collision between aircraft by generating, in a timely manner, an alert of a potential or actual infringement of separation minima. STCA must alert when the separation provision layer has been compromised but must also provide sufficient warning time to allow for corrective action, i.e. thus avoiding an airborne collision avoidance system (ACAS) resolution advisory (RA) will be generated. In some environments this necessitates the use of separation minima in STCA that are significantly lower than the separation minima used in the separation provision layer. STCA is only effective when each alert causes the controller to immediately assess the situation and if necessary take appropriate action.

There is presently no system compatibility between STCA (which advises of pending conflict to ATC only) and ACAS (which provides both advisory and mandatory resolution to the pilot only). However, both systems can complement each other and procedures need to be in place, that takes into account the limitations and advantages of each system.

Element 2: Area proximity warning (APW)

This element is intended to warn the controller, about unauthorized penetration of an airspace volume by generating, in a timely manner, an alert of a potential or actual infringement of the required spacing to that airspace volume. APW can be used to protect static, fixed airspace volumes (e.g. danger areas) but increasingly also dynamic, modular airspace volumes to enable flexible use of airspace.

Element 3: Minimum safe altitude warning (MSAW)

This element is intended to warn the controller, about increased risk of controlled flight into terrain accidents by generating, in a timely manner, an alert of aircraft proximity to terrain or obstacles. MSAW is only effective when each alert causes the controller to immediately assess the situation and if necessary take appropriate action.

Intended performance operational improvement/metric to determine success

In terms of safety this module contributes to the significant reduction of the number of major incidents.

The business case for this element is entirely made around safety and the application of ALARP (as low as reasonably practicable) in risk management.

The relevant PANS-ATM provisions exist. In addition they must regularly analyze the data and circumstances pertaining to each alert in order to identify and correct any shortcomings pertaining to ground-based safety nets, airspace design and ATC procedures.

Necessary system capability

Avionics

Aircraft should support cooperative surveillance using existing technology such as Mode C/S transponder or ADS-B out.

Ground systems

ATS units providing surveillance services must be equipped with the ground-based safety nets that are appropriate and optimized for their environment. Appropriate offline tools should be available to support the analysis of every safety alerts.

Human factors considerations

The generated alerts should normally be appropriate and timely, and the controller should understand under which circumstances interactions can occur with normal control practices or airborne safety nets. The two main issues from human performance are related to nuisance alerts which should be kept to a minimum and warning time for a genuine alert which should be high enough to support the completion of the procedure.

The use of ground-based safety nets will depend on the controller‘s trust. Trust is a result of many factors such as reliability and transparency. Neither mistrust nor complacency is desirable; training and experience is needed to develop trust at the appropriate level.

Training and qualification requirements

Controllers must receive specific ground-based safety nets training and be assessed as competent for the use of the relevant ground-based safety nets and recovery techniques.

Reference documents and guidance material

- PANS-ATM (Doc 4444), section 15.7.2 and 15.7.4
- EUROCONTROL Specifications for STCA, APW, MSAW and APM, available at http://www.EUROCONTROL.int/safety-nets

Module summary

<table>
<tr><td colspan="6"><u>Title of the Module:</u>
B0-102: Increased Effectiveness of Ground-Based Safety Nets</td></tr>
<tr><td colspan="2"><u>Elements:</u>
1. Short Term Conflict Alert (STCA)
2. Area Proximity Warning (APW)
3. Minimum Safe Altitude Warning (MSAW)</td><td colspan="2"><u>Equipage/Air</u>
- SSR Mode C/S transponder
- ADS-B OUT</td><td colspan="2"><u>Equipage/Ground</u>
- Short Term Conflict Alert,
- Area Proximity Warnings and
- Minimum Safe Altitude Warnings</td></tr>
<tr><td colspan="6">Implementation monitoring and intended performance impact</td></tr>
<tr><td rowspan="2"><u>Implementation progress</u>
1. Indicator:
Percentage of ATS units with ground based safety nets</td><td colspan="5">Qualitative performance benefits associated with five main KPAs only</td></tr>
<tr><td><u>KPA-Access/Equity</u>
Not Applicable</td><td><u>KPA-Capacity</u>
Not Applicable</td><td><u>KPA-Efficiency</u>
Not Applicable</td><td><u>KPA-Environment</u>
Not Applicable</td><td><u>KPA-Safety</u>
Significant reduction of the number of major incidents.</td></tr>
</table>

PERFORMANCE IMPROVEMENT AREA 4: EFFICIENT FLIGHT PATH – THROUGH TRAJECTORY-BASED OPERATIONS

B0-05: Improved Flexibility and Efficiency in Descent Profiles (CDO)

Introduction

Flexibility in airspace design should realize further reductions in emissions and aircraft noise impacts and facilitate reduced separation and flow management to increase overall capacity in terminal areas. The stability and predictability of flight paths assist pilot and air traffic controllers decision-making. This module integrates with other airspace and procedures (continuous descent operations (CDO), performance-based navigation (PBN) and airspace management) to increase efficiency, safety, access and predictability.

As traffic demand increases, the challenges in terminal areas center on volume, hazardous meteorological conditions (such as severe turbulence and low visibility), adjacent airports and special activity airspace in close proximity whose procedures utilize the same airspace, and policies that limit capacity, throughput, and efficiency.

Traffic flow and loading (across ingress and egress routes) are not always well-metered, balanced or predictable. Obstacle and airspace avoidance (in the form of separation minima and criteria), noise abatement procedures, as well as wake encounter risk mitigation, tend to result in operational inefficiencies (e.g. added time or distance flown, thus more fuel).

Inefficient routing can also cause under-use of available airfield and airspace capacity. Finally, challenges are presented to States by serving multiple customers (international and domestic with various capabilities): the intermingling of commercial, business, general aviation and many times military traffic destined to airports within a terminal area that interact and at times inhibit each other‘s operations.

Baseline

The baseline for this module may vary from one State, to the next. Noted is the fact that some aspects of the movement to PBN have already been the subject of local improvements in many areas; and these areas and users are already realizing benefits.

Change brought by the module

Flight operations in many terminal areas precipitate the majority of current airspace delays in many States. Opportunities to optimize throughput, improve flexibility, enable fuel-efficient climb and descent profiles, and increase capacity at the most congested areas should be a high-priority initiative in the near-term.

The core capabilities that should be leveraged are RNAV; RNP where needed; CDO; where possible, increased efficiencies in terminal separation rules in airspace; effective airspace design and classification; air traffic control (ATC) flow and ATC surveillance. Opportunities to reduce emissions and aircraft noise impacts should also be leveraged where possible.

Aircraft equipage is a significant contributor and the reliance on area navigation (RNAV) and required navigation performance (RNP) capabilities requires the continued development of PBN provisions as well as increased PBN implementation worldwide. ICAO provisions and guidance material are also necessary to support trajectory modelling and trajectory information exchange, and enhanced provisions for data link applications and messages will support exchange of trajectory data.

Element 1: Continuous descent operations

Continuous descent is one of several tools available to aircraft operators and ANSPs to benefit from existing aircraft capabilities and reduce noise, fuel burn and the emission of greenhouse gases. Over the years, different route models have been developed to facilitate CDO and several attempts have been made to strike a balance between the ideal of environmentally friendly procedures and the requirements of a specific airport or airspace.

CDO can provide for a reduction in fuel burn and emissions, while increasing flight stability and the predictability of flight path to both controllers and pilots, without compromising the optimal airport arrival rate (AAR).

CDO is enabled by airspace design, procedure design and facilitation by ATC, in which an arriving aircraft descends continuously, to the greatest possible extent, by employing minimum engine thrust, ideally in a low drag configuration, prior to the final approach fix/final approach point (FAF/FAP). An optimum CDO starts from the top-of-descent (TOD) and uses descent profiles that reduce controller-pilot communications and segments of level flight.

Furthermore it provides for a reduction in noise, fuel burn and emissions, while increasing flight stability and the predictability of flight path to both controllers and pilots.

Element 2: Performance-based navigation

PBN is a global set of area navigation standards, defined by ICAO, based on performance requirements for aircraft navigating on departure, arrival, approach or en-route.

These performance requirements are expressed as navigation specifications in terms of accuracy, integrity, continuity, availability and functionality required for a particular airspace or airport.

PBN will eliminate the regional differences of various required navigation performance (RNP) and area navigation (RNAV) specifications that exist today. The PBN concept encompasses two types of navigation specifications:

a) RNAV specification: 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 1; and

b) RNP specification: 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.

Intended performance operational improvement

Metrics to determine the success of the module are proposed in the Manual on Global Performance of the Air Navigation System (Doc 9883).

In terms of Efficiency cost savings and environmental benefits through reduced fuel burn and optimal management of the top-of-descent in the en-route airspace have a positive impact as well as the positive contribution on environment.

There is more predictability in more consistent flight paths and stabilized approach paths reducing the need for vectors and contributing on the ATC workload.

In addition the reduction in the incidence of controlled flight into terrain (CFIT) added to separation with the surrounding traffic and the reduction of number of conflicts contribute to safety also.

In terms of potential savings as a result of CDO implementation, it is important to consider that CDO benefits are heavily dependent on each specific ATM environment. Nevertheless, if implemented within the ICAO CDO manual framework, it is envisaged that the benefit/cost ratio (BCR) will be positive.

Necessary procedures (air and ground)

The ICAO Continuous Descent Operations (CDO) Manual (Doc 9931) provides guidance on the airspace design, instrument flight procedures, ATC facilitation and flight techniques necessary to enable continuous descent profiles.

It therefore provides background and implementation guidance for:

a) air navigation service providers (ANSPs);
b) aircraft operators;
c) airport operators; and
d) aviation regulators.

The ICAO Performance-based Navigation (PBN) Manual (Doc 9613) provides general guidance on PBN implementation. This manual identifies the relationship between RNAV and RNP applications and the advantages and limitations of choosing one or the other as the navigation requirement for an airspace concept.

It also aims at providing practical guidance to States, ANSPs and airspace users on how to implement RNAV and RNP applications, and how to ensure that the performance requirements are appropriate for the planned application.

Necessary system capability

Avionics

CDO is an aircraft operating technique aided by appropriate airspace and procedure design and appropriate ATC clearances enabling the execution of a flight profile optimized to the operating capability of the aircraft, with low engine thrust settings and, where possible, a low drag configuration, thereby reducing fuel burn and emissions during descent.

The optimum vertical profile takes the form of a continuously descending path, with a minimum of level flight segments only as needed to decelerate and configure the aircraft or to establish on a landing guidance system (e.g. ILS).

The optimum vertical path angle will vary depending on the type of aircraft, its actual weight, the wind, air temperature, atmospheric pressure, icing conditions and other dynamic considerations.

Ground systems

Within an airspace concept, PBN requirements will be affected by the communication, surveillance and ATM environments, the NAVAID infrastructure and the functional and operational capabilities needed to meet the ATM application.

PBN performance requirements also depend on what reversionary, non-RNAV means of navigation are available and what degree of redundancy is required to ensure adequate continuity of functions. Ground automation needs initially little changes to support CDO: potentially a flag on the display. For better integration the ground trajectory calculation function will need to be upgraded.

Human factors considerations

The decision to plan for RNAV or RNP has to be decided on a case by case basis in consultation with the airspace user. Some areas need only a simple RNAV to maximize the benefits, while other areas such as nearby steep terrain or dense air traffic may require the most stringent RNP.

Human factors have been taken into consideration during the development of the processes and procedures associated with this module. Where automation is to be used, the human-machine interface has been considered from both a functional and ergonomic perspective. The possibility of latent failures however, continues to exist and vigilance is requested during all implementation actions. It is further requested that human factor issues, identified during implementation, are reported to the international community through ICAO as part of any safety reporting initiative.

Training and qualification requirements

Since required navigation performance authorization required (RNP AR) approaches also require significant training, ANSPs should work closely with airlines to determine where RNP AR approach should be implemented. In all cases PBN implementation needs to be an agreement between the airspace user, the ANSP and the regulatory authorities.

Training in the operational standards and procedures are required for this module and can be found in the links to the documents in Section 8 to this module. Likewise, the qualifications requirements are identified in the regulatory requirements in Section 6 which form an integral part to the implementation of this module.

Regulatory/standardization needs and approval plan (air and ground)

Regulatory/standardization: use current published requirements that include the material given below. Approval plans: must be in accordance with application requirements e.g. airspace design, air traffic operations, PBN requirements for fixed radius transitions, radius-to-fix legs, required time of arrival (RTA), parallel offset, etc.

Reference documents and guidance material

- For flight plan requirements in Amendment 1, ICAO Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444).
- ICAO Doc 9613, Performance-based Navigation (PBN) Manual
- ICAO Doc 9931, Continuous Descent Operations (CDO) Manual
- SAM Advisory Circulars.

Module summary

Title of the Module: **B0-05: Improved Flexibility and Efficiency in Descent Profiles (CDO)**					
Elements: 1. CDO 2. PBN STARs		Equipage/Air - Nil		Equipage/Ground - Nil	
Implementation monitoring and intended performance impact					
Implementation progress	Qualitative performance benefits associated with five main KPAs only				
1. Indicator: *Percentage of international aerodromes with CDO implemented* 2. Indicator: *Percentage of international aerodromes/TMAs with PBN STARs implemented*	KPA-Access/Equity Not Applicable	KPA-Capacity Not Applicable	KPA-Efficiency Cost savings through reduced fuel burn. Reduction in the number of required radio transmissions.	KPA-Environment Reduced emissions as a result of reduced fuel burn	KPA-safety More consistent flight paths and stabilized approach paths. Reduction in the incidence of controlled flight into terrain (CFIT).

B0-20: Improved Flexibility and Efficiency in Departure Profiles (CCO)

Introduction

This module integrates with other airspace and procedures (PBN, continuous descent operations (CDO), and airspace management) to increase efficiency, safety, access and predictability; and minimize fuel use, emissions, and noise.

As traffic demand increases, the challenges in terminal areas center on volume, hazardous meteorological conditions (such as severe turbulence and low visibility), adjacent airports and special activity airspace in close proximity whose procedures utilize the same airspace, and policies that limit capacity, throughput, and efficiency.

Traffic flow and loading (across arrival and departure routes) are not always well metered, balanced or predictable. Obstacle and airspace avoidance (in the form of separation minima and criteria), noise abatement procedures and noise sensitive areas, as well as wake encounter risk mitigation, tend to result in operational inefficiencies (e.g. added time or distance flown, thus more fuel).

Inefficient routing can also cause under-use of available airfield and airspace capacity. Finally, challenges are presented to States by serving multiple customers (international and domestic with various capabilities): the intermingling of commercial, business, general aviation and many times military traffic destined to airports within a terminal area that interact and at times inhibit each other's operations.

Baseline

Flight operations in many terminal areas precipitate the majority of current airspace delays in many States. Opportunities to optimize throughput, improve flexibility, enable fuel-efficient climb and descent profiles, and increase capacity at the most congested areas should be a high-priority initiative in the near-term.

The baseline for this module may vary from one State, region or location to the next. Noted is the fact that some aspects of the movement to PBN have already been the subject of local improvements in many areas; these areas and users are already realizing benefits.

The lack of ICAO PBN operational approval guidance material and subsequently the emergence of States or regional approval material, which may differ or be even more demanding than intended, is slowing down implementation and is perceived as one of the main roadblocks for harmonization.

There is still some work to be done to harmonize PBN nomenclature, especially in charts and States/regional regulations (e.g. most of European regulations still make use of basic area navigation (B-RNAV) and precision area navigation (P-RNAV).

Efficiency of climb profiles may be compromised by level off segments, vectoring, and an additional overload of radio transmissions between pilots and air traffic controllers. Existing procedure design techniques do not cater for current FMS capability to manage the most efficient climb profiles. There is also excessive use of radio transmissions due to the need to vector aircraft in an attempt to accommodate their preferred trajectories.

Change brought by the module

The core capabilities that should be leveraged are RNAV; RNP where possible and needed; continuous climb operations (CCO), increased efficiencies in terminal separation rules; effective airspace design and classification; and air traffic flow. Opportunities to reduce flight block times, fuel/emissions and aircraft noise impacts should also be leveraged where possible.

This module is a first step towards harmonization and a more optimized organization and management of the airspace. Many States will require knowledgeable assistance to achieve implementation. Initial implementation of PBN, RNAV for example, takes advantage of existing ground technology and avionics and allows extended collaboration of air navigation service providers (ANSPs) with partners: military, airspace users, and neighbouring States. Taking small and required steps and only performing what is needed or required allows States to rapidly exploit PBN.

Other remarks

Operating at the optimum flight level is a key driver to improve flight fuel efficiency and minimizing atmospheric emissions. A large proportion of fuel burn occurs in the climb phase and for a given route length, taking into account aircraft mass and the meteorological conditions for the flight, there will be an optimum flight level, which gradually increases as the fuel on-board is used up and aircraft mass therefore reduces. Enabling the aircraft to reach and maintain its optimum flight level without interruption will therefore help to optimize flight fuel efficiency and reduce emissions.

CCO can provide for a reduction in noise, fuel burn and emissions, while increasing flight stability and the predictability of flight path to both controllers and pilots.

CCO is an aircraft operating technique aided by appropriate airspace and procedure design and appropriate air traffic control (ATC) clearances enabling the execution of a flight profile optimized to the operating capability of the aircraft, thereby reducing fuel burn and emissions during the climb portion of flight.

The optimum vertical profile takes the form of a continuously climbing path, with a minimum of level flight segments only as needed to accelerate and configure the aircraft.

The optimum vertical path angle will vary depending on the type of aircraft, its actual weight, the wind, air temperature, atmospheric pressure, icing conditions and other dynamic considerations.

A CCO can be flown with or without the support of a computer-generated vertical flight path (i.e. the vertical navigation (VNAV) function of the flight management system (FMS)) and with or without a fixed lateral path. The maximum benefit for an individual flight is achieved by allowing the aircraft to climb on the most efficient climb profile along the shortest total flight distance possible.

Intended performance operational improvement

Metrics to determine the success of the module are proposed in the Manual on Global Performance of the Air Navigation System (Doc 9883).

An optimal management and efficient aircraft operating profiles with reduction in the number of required radio transmissions and lower pilot and air traffic control workload have a positive impact in terms of efficiency.

It is important to consider that CCO benefits are heavily dependent on each specific ATM environment. Nevertheless, if implemented within the ICAO CCO manual framework, it is envisaged that the benefit/cost ratio (BCR) will be positive.

Necessary procedures (air and ground)

The ICAO *Performance-based Navigation (PBN) Manual* (Doc 9613) provides general guidance on PBN implementation.

This manual identifies the relationship between RNAV and RNP applications and the advantages and limitations of choosing one or the other as the navigation requirement for an airspace concept.

It also aims at providing practical guidance to States, ANSPs and airspace users on how to implement RNAV and RNP applications, and how to ensure that the performance requirements are appropriate for the planned application.

The ICAO *Continuous Climb Operations (CCO) Manual* (Doc xxxx – under development) provides guidance on the airspace design, instrument flight procedures, ATC facilitation and flight techniques necessary to enable continuous descent profiles.

It therefore provides background and implementation guidance for:

a) air navigation service providers;
b) aircraft operators;
c) airport operators; and d) aviation regulators.

Necessary system capability

Avionics

CCO does not require a specific air or ground technology. It is an aircraft operating technique aided by appropriate airspace and procedure design, and appropriate ATC clearances enabling the execution of a flight profile optimized to the operating capability of the aircraft, in which the aircraft can attain cruise altitude flying at optimum air speed with climb engine thrust settings set throughout the climb, thereby reducing total fuel burn and emissions during the whole flight. Reaching cruise flight levels sooner where higher ground speeds are attained can also reduce total flight block times. This may allow a reduced initial fuel upload with further fuel, noise and emissions reduction benefits.

The optimum vertical profile takes the form of a continuously climbing path. Any level or non-optimal reduced climb rate segments during the climb to meet aircraft separation requirements should be avoided. Achieving this whilst also enabling CDO is critically dependent upon the airspace design and the height windows applied in the instrument flight procedure. Such designs need an understanding of the optimum profiles for aircraft operating at the airport to ensure that the height windows avoid, to greatest extent possible, the need to resolve potential conflicts between the arriving and departing traffic flows through ATC height or speed constraints.

Ground systems

Controllers would benefit from some automation support to display aircraft capabilities in order to know which aircraft can do what.

Human factors considerations

Human factors have been taken into consideration during the development of the processes and procedures associated with this module. Where automation is to be used, the human-machine interface has been considered from both a functional and ergonomic perspective. The possibility of latent failures however, continues to exist and vigilance is requested during all implementation actions. It is further requested that human factor issues, identified during implementation, be reported to the international community through ICAO as part of any safety reporting initiative.

Training and qualification requirements

Training in the operational standards and procedures are required for this module and can be found in the links to the documents below.

Regulatory/standardization needs and approval plan (air and ground)

Regulatory/standardization: use current published requirements that include the guidance material

Approval plans: must be in accordance with application requirements.

Understanding the policy context is important for making the case for local CCO implementation and ensuring high levels of participation. CCO may be a strategic objective at international, State, or local level, and as such, may trigger a review of airspace structure when combined with CDO.

For example, noise contour production may be based on a specific departure procedure (noise abatement departure procedure 1 (NADP1) or NADP2-type). Noise performance can be improved in some areas around the airport, but it may affect existing noise contours elsewhere. Similarly CCO can enable several specific strategic objectives to be met and should therefore be considered for inclusion within any airspace concept or redesign. Guidance on airspace concepts and strategic objectives is contained in the Performance-based Navigation (PBN) Manual (Doc 9613).

Objectives are usually collaboratively identified by airspace users, ANSPs, airport operators as well as by government policy. Where a change could have an impact on the environment, the development of an airspace concept may involve local communities, planning authorities and local government, and may require formal impact assessment under regulations.

Such involvement may also be the case in the setting of the strategic objectives for airspace. It is the function of the airspace concept and the concept of operations to respond to these requirements in a balanced, forward-looking manner, addressing the needs of all stakeholders and not of one of the stakeholders only (e.g. the environment). Doc 9613, Part B, Implementation Guidance, details the need for effective collaboration among these entities.

In the case of a CCO, the choice of a departure procedure (NADP1 or NADP2-type), requires a decision of the dispersion of the noise. In addition to a safety assessment, a transparent assessment of the impact of CCO on other air traffic operations and the environment should be developed and made available to all interested parties.

Reference documents and guidance material

- *ICAO Doc 8168, Procedures for Air Navigation Services — Aircraft Operations*
- ICAO Doc 4444, *Procedures for Air Navigation Services — Air Traffic Management Guidance Material*
- ICAO Doc 9613, *Performance-based Navigation (PBN) Manual*
- ICAO Doc xxxx, *Continuous Climb Operations (CCO) Manual* (only in English yet)

Module summary

<table>
<tr><td colspan="6"><u>Title of the Module:</u>
B0-20: Improved Flexibility and Efficiency in Departure Profiles (CCO)</td></tr>
<tr><td colspan="2"><u>Elements:</u>
1. CCO
2. PBN SIDs</td><td colspan="2"><u>Equipage/Air</u>
- Nil</td><td colspan="2"><u>Equipage/Ground</u>
- Nil</td></tr>
<tr><td colspan="6">Implementation monitoring and intended performance impact</td></tr>
<tr><td rowspan="2"><u>Implementation progress</u>
1. Indicator: Percentage of international aerodromes with CCO implemented

2. Indicator: Percentage of international aerodromes with PBN SIDs implemented</td><td colspan="5">Qualitative performance benefits associated with five main KPAs only</td></tr>
<tr><td><u>KPA-Access/Equity</u>
Not Applicable</td><td><u>KPA-Capacity</u>
Not Applicable</td><td><u>KPA-Efficiency</u>
Cost savings through reduced fuel burn and efficient aircraft operating profiles.
Reduction in the number of required radio transmissions.</td><td><u>KPA-Environment</u>
Authorization of operations where noise limitations would otherwise result in operations being curtailed or restricted.
Environmental benefits through reduced emissions.</td><td><u>KPA-Safety</u>
More consistent flight paths.
Reduction in the number of required radio transmissions.
Lower pilot and air traffic control workload</td></tr>
</table>

<u>B0-40: Improved Safety and Efficiency through the initial application of Data Link En-Route</u>

Introduction

Air-ground data exchanges have been the subject of decades of research and standardization work and are an essential ingredient of the future operational concepts since they can carry reliably richer information than what can be exchanged over radio. This module covers what is available and can be used more widely now.

One element of the module is the transmission of aircraft position information, forming the automatic dependent surveillance contract (ADS-C), principally for use over oceanic and remote areas where radar cannot be deployed for physical or economic reasons.

A second element is controller pilot data link communications (CPDLC) comprising a first set of data link applications allowing pilots and controllers to exchange ATC messages concerning communications management, ATC clearances and stuck microphones. CPDLC reduces misunderstandings and controller workload giving increased safety and efficiency whilst providing extra capacity in the ATM system.

Baseline

Prior to this module, air-ground communications used voice radio (VHF or HF depending on the airspace), known for limitations in terms of quality, bandwidth and security. There are also wide portions of the region with no radar surveillance. ATC instructions, position reports and other information have to be transmitted through HF radios where voice quality is especially bad most of the time, leading to significant workload to controllers and pilots (including HF radio operators), poor knowledge of the traffic situation outside radar coverage, large separation minima, and misunderstandings. In high density airspace controllers currently spend 50% of their time talking to pilots on the VHF voice channels where frequencies are a scarce resource; this also represents a significant workload for controllers and pilots and generates misunderstandings.

Change brought by the module

The module concerns the implementation of a first package of data link applications, covering ADS-C, CPDLC and other applications for ATC. These applications provide significant improvement in the way ATS is provided as described in the next section.

At the moment, data link implementations are based on different standards, technology and operational procedures, although there are many similarities.

Element 1: ADS-C over oceanic and remote areas

ADS-C provides an automatic dependent surveillance service over oceanic and remote areas, through the exploitation of position messages sent automatically by aircraft over data link at specified time intervals. This improved situational awareness (in combination with appropriate PBN levels) is improving safety in general and allows reducing separations between aircraft and progressively moving away from pure procedural modes of control.

Element 2: Continental CPDLC

This application allows pilots and controllers to exchange messages with a better quality of transmission. In particular, it provides a way to alert the pilot when the microphone is stuck as well as a complementary means of communication. CPDLC is used as supplemental means of communications. Voice remains primary.

Over dense continental airspace, they can significantly reduce the communication load, allowing better task organization by the controller, in particular by not having to interrupt immediately to answer radio. They provide more reliability for the transmission and understanding of frequency changes, flight levels and flight information etc, thereby increasing safety and reducing the number of misunderstandings and repetitions.

Intended performance operational improvement

Metrics to determine the success of the module are proposed in the Manual on Global Performance of the Air Navigation System (Doc 9883).

Element 1: ADS-C over oceanic and remote areas

<u>Capacity</u>

A better localization of traffic and reduced separations allow increasing the offered capacity.

Efficiency

Routes/tracks and flights can be separated by reduced minima, allowing to apply flexible routings and vertical profiles closer to the user-preferred ones.

Flexibility

ADS-C permits to make route changes easier

Safety

Increased situational awareness; ADS-C based safety nets like cleared level adherence monitoring, route adherence monitoring, danger area infringement warning; better support to search and rescue.

Cost Benefit Analysis

The business case has proven to be positive due to the benefits that flights can obtain in terms of better flight efficiency (better routes and vertical profiles; better and tactical resolution of conflicts).

Element 2: Continental CPDLC

Capacity

Reduced communication workload and better organization of controller tasks allowing to increase sector capacity

Safety

Increased situational awareness; reduced occurrences of misunderstandings; solution to stuck microphone situations

Cost Benefit Analysis

It has to consider:

a) the benefits that flights can obtain in terms of better flight efficiency (better routes and vertical profiles; better and tactical resolution of conflicts); and
b) reduced controller workload and increased capacity.

Necessary procedures (air and ground)

Procedures have been described and are available in ICAO documents: *Manual of Air Traffic Services Data Link Applications* (Doc 9694) and the Global Operational Data Link Document (GOLD). Currently GOLD and LINK2000+ operational material is being merged, leading to an update of GOLD that allows global applicability, independent from airspace and technology.

Necessary system capability

Avionics

Standards for the enabling technology are available in ICAO documents and industry standards. Today, the existing data link implementations are based on two sets of ATS data link services: FANS 1/A and ATN B1, both will exist. FANS1/A is deployed in oceanic and remote regions whilst ATN B1 is being implemented in Europe according to European Commission legislation (EC Reg. No. 29/2009) – the data link services implementing rule.

These two packages are different from the operational, safety and performance standpoint and do not share the same technology but there are many similarities and can be accommodated together, thanks to the resolution of the operational and technical issues through workaround solutions, such as accommodation of FANS 1/A aircraft implementations by ATN B1 ground systems and dual stack (FANS 1/A and ATN B1) implementations in the aircraft.

Ground systems

For ground systems, the necessary technology includes the ability to manage ADS-C contract, process and display the ADS-C position messages. CPDLC messages need to be processed and displayed to the relevant ATC unit. Enhanced surveillance through multi-sensor data fusion facilitates transition to/from radar environment.

Human factors considerations

ADS-C is a means to provide the air traffic controller with a direct representation of the traffic situation, and reduces the task of controllers or radio operators to collate position reports. In addition to providing another channel of communications, the data link applications allow in particular air traffic controllers to better organize their tactical tasks. Both pilots and controllers benefit from a reduced risk of misunderstanding of voice transmissions.

Data communications allow reducing the congestion of the voice channel with overall understanding benefits and more flexible management of air-ground exchanges. This implies an evolution in the dialogue between pilots and controllers which must be trained to use data link rather than radio. Automation support is needed for both the pilot and the controller. Overall, their respective responsibilities will not be affected.

Human factors have been taken into consideration during the development of the processes and procedures associated with this module. Where automation is to be used, the human-machine interface has been considered from both a functional and ergonomic perspective. The possibility of latent failures however, continues to exist and vigilance is requested during all implementation actions. It is further requested that human factor issues, identified during implementation, be reported to the international community through ICAO as part of any safety reporting initiative.

Training and qualification requirements

Automation support is needed for both the pilot and the controller which therefore will have to be trained to the new environment and to identify the aircraft/facilities which can accommodate the data link services in mixed mode environments**.**

Training in the operational standards and procedures are required for this module and can be found in the links to the documents in Section 8 to this module. Likewise, the qualifications requirements are identified in the regulatory requirements in Section 6 which form an integral part to the implementation of this module.

Regulatory/standardization needs and approval plan (air and ground)

Regulatory/standardization: use current published requirements that include the guidance material. It should also be noted that new ICAO OPLINK OPS guidance material is under development.

Approval plans: must be in accordance with application requirements.

The GOLD ad hoc working group is working on an update of GOLD-Ed 1 in the framework of harmonization of procedures independent from airspace and technology.

Reference documents and guidance material

- ICAO Doc 9694, Manual of Air Traffic Services Data Link Applications.
- Global Operation Data Link Document (GOLD) Ed 2 (under development).
- Commission Regulation (EC) No 29/2009 of 16 January 2009 laying down requirements on data link services for the single European sky.
- EUROCAE ED-100A/RTCA DO-258A, Interoperability Requirements for ATS Applications using ARINC 622 Data Communications.
- EUROCAE ED-110B/RTCA DO-280B, Interoperability Requirements Standard for Aeronautical Telecommunication Network Baseline 1 (Interop ATN B1).
- EUROCAE ED-120/RTCA DO-290, Safety and Performance Requirements Standard for Initial Air Traffic Data Link Services In Continental Airspace (SPR IC).
- EUROCAE ED-122/RTCA DO-306, Safety and Performance Standard for Air Traffic Data Link Services in Oceanic and Remote Airspace (Oceanic SPR Standard).
- EUROCAE ED-154A/RTCA DO-305A, Future Air Navigation System 1/A – Aeronautical Telecommunication Network Interoperability Standard (FANS 1/A – ATN B1 Interop Standard).

Module summary

Title of the Module: **B0-40: Improved Safety and Efficiency through the initial application of Data Link En-Route**					
Elements: 1. ADS-C over oceanic and remote areas 2. Continental CPDLC		Equipage/Air - FANS 1/A; ATN B1		Equipage/Ground - ADS-C - VDL Mode 2/Continental CPDLC	
Implementation monitoring and intended performance impact					
Implementation progress 1. Indicator: *Number of ADS-C /CPDLC procedures available over oceanic and remote Areas*	Qualitative performance benefits associated with five main KPAs only				
	KPA-Access/ Equity Not Applicable	KPA-Capacity A better localization of traffic and reduced separation allow increased capacity. Reduced communication workload and better organization of controller tasks allowing increasing sector capacity.	KPA-Efficiency Routes/tracks and flights can be separated by reduced minima, allowing to apply flexible routings and vertical profiles closer to the user-preferred ones.	KPA-Environment Reduced emissions as a result of reduced fuel burn.	KPA-afety ADS-C based safety nets supports cleared level adherence monitoring, route adherence monitoring, danger area infringement warning and improved search and rescue. Reduced occurrences of misunderstandings; solution to stuck microphone situations.

ATTACHMENT E

AIR NAVIGATION REPORT FORM
HOW TO USE - EXPLANATORY NOTES

1. **Air Navigation Report Form (ANRF):** This form provides a standardized approach to implementation monitoring and performance measurement of Aviation System Block Upgrades (ASBU) Modules. The Planning and Implementation Regional Groups (PIRGs) and States could use this report format for their planning, implementation and monitoring framework for ASBU Modules. Also, other reporting formats that provide more details may be used but should contain as a minimum the elements described below. The Reporting and monitoring results will be analysed by ICAO and aviation partners and then utilized in developing the Annual Global Air Navigation Report. The Global Air Navigation Report conclusions will serve as the basis for future policy adjustments aiding safety practicality, affordability and global harmonization, amongst other concerns.

2. **Regional/National Performance objective:** In the ASBU methodology, the performance objective will be the title of the ASBU module itself. Furthermore, indicate alongside corresponding Performance Improvement area (PIA). Consequently, for ASBU Block 0, a total of 18 ANRFs will need to be developed that reflects respective 18 Modules.

3. **Impact on Main Key Performance Areas:** Key to the achievement of a globally interoperable ATM system is a clear statement of the expectations/benefits to the ATM community. The expectations/benefits are referred to eleven Key Performance Areas (KPAs) and are interrelated and cannot be considered in isolation since all are necessary for the achievement of the objectives established for the system as a whole. It should be noted that while safety is the highest priority, the eleven KPAs shown below are in alphabetical order as they would appear in English. They are access/equity; capacity; cost effectiveness; efficiency; environment; flexibility; global interoperability; participation of ATM community; predictability; safety; and security. However, out of these eleven KPAs, for the present, only five have been selected for reporting through ANRF, which are Access & Equity, Capacity, Efficiency, Environment and Safety. The KPAs applicable to respective ASBU module are to be identified by marking Y (Yes) or N (No).

4. **Implementation Progress:** This section indicates status of progress in the implementation of different elements of the ASBU Module for both air and ground segments.

5. **Elements related to ASBU module:** Under this section list elements that are needed to implement the respective ASBU Module. Furthermore, should there be elements that are not reflected in the ASBU Module (example: In ASBU B0-80/Airport CDM, Aerodrome certification and data link applications D-VOLMET, D-ATIS, D-FIS are not included; Similarly in ASBU B0-30/AIM, note that WGS-84 and eTOD are not included) but at the same time if they are closely linked to the module, ANRF should specify those elements. As a part of guidance to PIRGs/States, the FASID (Volume II) of every Regional ANP will have the complete list of all 18 Modules of ASBU Block 0 along with corresponding elements, equipage required on the ground and in the air as well as metrics specific to both implementation and benefits.

6. **Implementation Status (Ground/Air):** Planned implementation date (moth/year) and the current status/responsibility for each element are to be reported in this section. Please provide as much details as possible and should cover both avionics and ground systems. If necessary, use additional pages.

7. **Implementation Roadblocks/Issues**: Any problems/issues that are foreseen for the implementation of elements of the Module are to be reported in this section. The purpose of the section is to identify in advance any issues that will delay the implementation and if so, corrective action is to be initiated by the concerned person/entity. The four areas, under which implementation issues, if any, for the ASBU Module to be identified, are as follows:

- Ground System Implementation:
- Avionics Implementation:
- Procedures Availability:
- Operational Approvals:

Should be there no issues to be resolved for the implementation of ASBU Module, indicate as "NIL".

8. **Performance Monitoring and Measurement:** Performance monitoring and measurement is done through the collection of data for the supporting metrics. In other words, metrics are quantitative measure of system performance – how well the system is functioning. The metrics fulfil three functions. They form a basis for assessing and monitoring the provision of ATM services, they define what ATM services user value and they can provide common criteria for cost benefit analysis for air navigation systems development. The Metrics are of two types:

A. Implementation Indicators/supporting metrics: This indicator supported by the data collected for the metric reflects the status of implementation of elements of the Module. For example- Percentage of international aerodromes with CDO implemented. This indicator requires data for the metric "number of international aerodromes with CDO".

B. Benefit Metrics: This Metric allows to asses benefits accrued as a result of implementation of the module. The benefits or expectations, also known as Key Performance Areas (KPAs), are interrelated and cannot be considered in isolation since all are necessary for the achievement of the objectives established for the system as a whole. It should be noted that while safety is the highest priority, the eleven KPAs shown below are in alphabetical order as they would appear in English. They are access/equity; capacity; cost effectiveness; efficiency; environment; flexibility; global interoperability; participation of ATM community; predictability; safety; and security. However, out of these eleven KPAs, for the present, only five have been selected for reporting through ANRF, which are Access & Equity, Capacity, Efficiency, Environment and Safety. It is not necessary that every module contributes to all of the five KPAs. Consequently, a limited number of metrics per type of KPA, serving to measure the module(s)' implementation benefits, without trying to apportion these benefits between module, have been identified at the end of this table. This approach would facilitate States in collecting data for the chosen metrics.

On the basis of examples of Performance Indicators/supporting Metrics detailed in this document, PIRGs/States to reflect under this section the appropriate metrics that represents the monitoring of respective ASBU Module both in terms of implementation as well as benefits to five KPAs.

The impact on KPAs could be extended to more than five KPAs mentioned above if maturity of the system allows and the process is available within the State to collect the data.

Performance Improvement Area 1:
Airport Operations

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REGIONAL PERFORMANCE OBJECTIVE – B0-15: Improve Traffic Flow Through Runway Sequencing (AMAN/DMAN) **Performance Improvement Area 1: Airport Operations**					
ASBU B0-15: Impact on Main Key Performance Areas (KPA): KPA-02 – Capacity, KPA-04 – Efficiency, KPA-09 – Predictability, KPA-06 – Flexibility.					
	Access & Equity	**Capacity**	**Efficiency**	**Environment**	**Safety**
Applicable	N	Y	Y	N	N

ASBU B0-15: Implementation Progress	
Elements	**Implementation Status (Ground and Air)**
1. AMAN and time based metering	Dec. 2015
2. Departure management	Dec. 2015
3. Movement Area Capacity Optimization	Dec. 2015 – Airport operator

ASBU B0-15: Implementation Roadblocks/Issues				
Elements	**Implementation Area**			
	Ground System Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
1. AMAN and time based metering	Lack of automation system to support synchronization	NIL	Lack of appropriate training. Lack of STARs PBN Lack of Slots assignment.	
2. Departure management	Lack of automation system to support synchronization	NIL	Lack of slots assignment. Lack of SIDs PBN Lack of appropriate training	
3. Movement Area Capacity Optimization	NIL	NIL	Lac of procedures for RWY, TWY & platform capacity calculation. Guidelines for movement area capacity optimization	NIL

ASBU B0-15: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
1. AMAN and time based metering	Indicator: Percentage of international aerodromes with AMAN and time based metering Supporting metric: Number of international airport with AMAN and time based metering
2. Departure management	Indicator: Percentage of international aerodromes with DMAN Supporting metric: Number of international airport DMAN
3. Movement Area Capacity Optimization	Indicator: percentage of international aerodromes with Airport-capacity calculated Supporting metric: Number of international aerodromes with Airport capacity calculated.

ASBU B0-15: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	**Benefits**
Access & Equity	Not applicable.
Capacity	Increase airport movement area capacity through optimization.
Efficiency	Efficiency is positively impacted as reflected by increased runway throughput and arrival rates.
Environment	Not applicable.
Safety	Not applicable.

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REGIONAL PERFORMANCE OBJECTIVE – B0-65: Optimization of Approach Procedures Including Vertical Guidance **Performance Improvement Area 1: Airport Operations**					
ASBU B0-65: Impact on Main Key Performance Areas (KPA)					
	Access & Equity	**Capacity**	**Efficiency**	**Environment**	**Safety**
Applicable	Y	Y	Y	Y	Y

ASBU B0-65: Implementation Progress	
Elements	**Implementation Status (Ground and Air)**
1. APV with Baro VNAV	December 2016 – Service Providers and users
2. APV with SBAS	Not applicable
3. APV with GBAS	December 2018 – Initial implementation at some States (services providers)

ASBU B0-65: Implementation Roadblocks/Issues				
Elements	**Implementation Area**			
	Ground system Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
1. APV with Baro VNAV	NIL	Insufficient number of equipped aircraft	Insufficient appropriate training	Lack of appropriate training
2. APV with SBAS	Not Applicable	Not applicable	Not applicable	Not applicable
3. APV with GBAS	Lack of cost benefit analysis Adverse ionosphere	Insufficient number of equipped aircraft	Insufficient appropriate training	Lack of appropriate training Evaluation of a real operational requirement

ASBU B0-65: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
1. APV with Baro VNAV	Indicator: Percentage of international aerodromes having instrument runways provided with APV with Baro VNAV procedure implemented Supporting metric: Number of international airport having approved APV with Baro VNAV procedure implemented
2. APV with SBAS	Not Applicable

ASBU B0-65: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
3. APV with GBAS	Indicator: Percentage of international aerodromes having instrument runways provided with APV GBAS procedure implemented Supporting metric: Number of international airport having APV GBAS procedure implemented.

ASBU B0-65: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	**Benefits**
Access & Equity	Increased aerodrome accessibility
Capacity	Increased runway capacity
Efficiency	Reduced fuel burn due to lower minima, fewer diversions, cancellations, delays
Environment	Reduced emissions due to reduced fuel burn
Safety	Increased safety through stabilized approach paths.

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REGIONAL/NATIONAL PERFORMANCE OBJECTIVE – B0-75: Safety and Efficiency of Surface Operations (A-SMGCS Level 1-2) **Performance Improvement Area 1:** **Airport operation**					
ASBU B0-75: Impact on Main Key Performance Areas (KPA)					
	Access & Equity	**Capacity**	**Efficiency**	**Environment**	**Safety**
Applicable	Y	Y	Y	Y	Y

B0-75: Implementation Progress	
Elements	**Implementation Status (Ground and Air)**
1. Surveillance system for ground surface movement (PSR, SSR, ADS B or Multilateration)	June 2018 Service provider
2. Surveillance system on board (SSR transponder, ADS B capacity)	June 2018 Service Provider
3. Surveillance system for vehicle	June 2018 Service Provider
4. Visual aids for navigation	December 2015 Service Provider
5. Wild life strike hazard reduction	December 2015 Aerodrome operator/wildlife committee
6. Display and processing information	June 2018 Service Provider

ASBU B0-75: Implementation Roadblocks/Issues				
Elements	**Implementation Area**			
	Ground System Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
1. Surveillance system for ground surface movement (PSR, SSR, ADS B or Multilateration)	NIL	NIL	Lack of procedures and training	Lack of inspector for approvals operations
2. Surveillance system on board (SSR transponder ,ADS B capacity)	NIL	Lack of surveillance system on board (ADS B capacity) On general aviation and some commercial aircraft	Lack of procedures and training	NIL
3. Surveillance system for vehicle	NIL	NIL	Lack of procedures and training	NIL

ASBU B0-75: Implementation Roadblocks/Issues				
Elements	**Implementation Area**			
	Ground System Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
4. Visual aids for navigation	Implementation of new technologies (such as LED) not compliant with Annex 14	NIL	NIL	NIL
5. Wild life strike hazard reduction	NIL	NIL	Lack of Aerodrome Wildlife Committee	NIL

ASBU B0-75: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
6. Surveillance system for ground surface movement (PSR, SSR, ADS B or Multilateration)	Indicator: Percentage of international aerodromes with SMR/ SSR Mode S/ ADS-B Multilateration for ground surface movement Supporting metric: Number of international aerodrome with SMR/ SSR Mode S/ ADS-B Multilateration for ground surface movement
7. Surveillance system on board (SSR transponder ,ADS B capacity)	Indicator: Percentage of surveillance system on board (SSR transponder, ADS B capacity) Supporting metric: Number of aircraft with surveillance system on board (SSR transponder ,ADS B capacity)
8. Surveillance system for vehicle	Indicator Percentage of international aerodromes with a cooperative transponder systems on vehicles Supporting metric: Number of vehicle with surveillance system installed
9. Visual aids for navigation	Indicator: Percentage of international aerodromes complying with visual aid requirements as per Annex 14 Supporting metric: Number of international aerodromes complying with visual aid requirements as per Annex 14
10. Wild life strike hazard reduction	Indicator: Percentage of reduction of wildlife incursions Supporting metric: Number of runway incursions due to wild life strike

ASBU B0-75: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	**Benefits**
Access & Equity	Improves portions of the manoeuvring area obscured from view of the control tower for vehicles and aircraft. Ensures equity in ATC handling of surface traffic regardless of the traffic's position on the international aerodrome
Capacity	Sustained level of aerodrome capacity during periods of reduced visibility
Efficiency	Reduced taxi times through diminished requirements for intermediate holdings based on reliance on visual surveillance only. Reduced fuel burn
Environment	Reduced emissions due to reduced fuel burn
Safety	Reduced runway incursions. Improved response to unsafe situations. Improved situational awareness leading to reduced ATC workload

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REGIONAL PERFORMANCE OBJECTIVE – B0-80: Improved Airport Operations through Airport - CDM **Performance Improvement Area 1: Airport Operations**					
ASBU B0-80: Impact on Main Key Performance Areas (KPA): KPA-02 – Capacity, KPA-04 – Efficiency, KPA-05 – Environment.					
	Access & Equity	**Capacity**	**Efficiency**	**Environment**	**Safety**
Applicable	N	Y	Y	Y	N

ASBU B0-80: Implementation Progress	
Elements	**Implementation Status (Ground and Air)**
1. Airport –CDM	Dec. 2015 – Airport Operator
2. Aerodrome certification	Dec 2018 – State CAA
3. Airport Planning	Dec. 2018 – State CAA
4. Heliport Operations	Dec. 2018 – State CAA

ASBU B0-80: Implementation Roadblocks/Issues				
Elements	**Implementation Area**			
	Ground System Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
1. Airport –CDM	Interconnection of ground systems of different partners for Airport-CDM	NIL	NIL	NIL
2. Aerodrome certification	NIL	NIL	LAR AGA	NIL
3. Airport Planning	NIL	NIL	NIL	NIL
4. Heliport Operations	NIL	NIL	NIL	NIL

ASBU B0-80: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
1. Airport –CDM	Indicator: Percentage of international aerodromes with Airport-CDM Supporting metric: Number of international aerodromes with Airport-CDM
2. Aerodrome certification	Indicator: Percentage of certified international aerodromes Supporting metric: Number of certified international aerodromes
3. Airport Planning	Indicator: Percentage of international aerodromes with Master Plans Supporting metric: Number of international aerodromes with Master Plans
4. Heliport Operations	Indicator: Percentage of Heliports with operational approval Supporting metric: Number of Heliports with operational approval

ASBU B0-80: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	**Benefits**
Access & Equity	Enhanced equity on the use of aerodrome facilities.
Capacity	Enhanced use of existing Implementation of gate and stands (unlock latent capacity). Reduced workload, better organization of the activities to manage flights. Enhanced aerodrome capacity according with the demand
Efficiency	Improved operational efficiency (fleet management); and reduced delay. Reduced fuel burn due to reduced taxi time and lower aircraft engine run time. Improved aerodrome expansion in accordance with Master Plan
Environment	Reduced emissions due to reduced fuel burn
Safety	Not applicable

Performance Improvement Area 2:
Globally Interoperable Systems and Data – Through Globally Interoperable System Wide Information Management

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REGIONAL/NATIONAL PERFORMANCE OBJECTIVE – B0-25: Increased Interoperability, Efficiency and Capacity through Ground-Ground Integration **Performance Improvement Area 2:** **Globally Interoperable Systems and Data – Through Globally Interoperable System Wide Information Management**					
ASBU B0-25: Impact on Main Key Performance Areas (KPA)					
	Access & Equity	**Capacity**	**Efficiency**	**Environment**	**Safety**
Applicable	N	Y	Y	N	Y

ASBU B0-25: Implementation Progress	
Elements	**Implementation Status (Ground and Air)**
1. Complete AMHS implementation at States still not counting with this system	December 2014 Services provider
2. AMHS interconnection	December 2014 Services provider
3. Implement AIDC /OLDI at SAM States automated centres	June 2014 Services provider
4. Implement operational AIDC/OLDI between adjacent ACC´s	June 2018 Services provider
5. Implement the new regional network (REDDIG II)	June 2014 Services provider

ASBU B0-25: Implementation Roadblocks/Issues				
Elements	**Implementation Area**			
	Ground System Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
1. Complete AMHS implementation at States still not counting with this system	NIL	NIL	NIL	NIL
2. AMHS interconnection	TPDI negotiations between MTAs	NIL	NIL	NIL
3. Implement AIDC /OLDI at SAM States automated centres	NIL	NIL	NIL	NIL
4. Implement operational AIDC/OLDI between adjacent ACC´s	Compatibility between AIDC or OLDI systems from various manufacturers	NIL	NIL	NIL

ASBU B0-25: Implementation Roadblocks/Issues				
Elements	Implementation Area			
	Ground System Implementation	Avionics Implementation	Procedures Availability	Operational Approvals
5. Implement the new regional network (REDDIG II)	NIL	NIL	NIL	NIL

ASBU B0-25: Performance Monitoring and Measurement (Implementation)	
Elements	Performance Indicators/Supporting Metrics
1. Complete AMHS implementation at States still not counting with this system	Indicator: Percentage of States with AMHS implemented Supporting metric: Number of AMHS installed
2. AMHS interconnection	Indicator: Percentage of States with AMHS interconnected with other AMHS Supporting metric: Number of AMHS interconnections implemented
3. Implement AIDC /OLDI at SAM States automated centres	Indicator: Percentage of ATS units with AIDC or OLDI Supporting metric: Number of AIDC or OLDI systems installed
4. Implement operational AIDC/OLDI between adjacent ACC´s	Indicator: Percentage of ACCs with AIDC or OLDI systems interconnection implemented Supporting metric: Number of AIDC interconnections implemented, as per CAR/SAM FASID Table CNS 1Bb
5. Implement the new regional network (REDDIG II)	Indicator: Percentage of phases completed for the implementation of the new digital network Supporting metric: Number of REDDIG II implementation phase

ASBU B0-25: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	Benefits
Access & Equity	NIL
Capacity	Reduced controller workload and increased data integrity supporting reduced separations translating directly to cross sector or boundary capacity flow increases
Efficiency	The reduced separation can also be used to more frequently offer aircraft flight levels closer to the optimum; in certain cases, this also translates into reduced en-route holding
Environment	NIL
Safety	Better knowledge of more accurate flight plan information

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REGIONAL PERFORMANCE OBJECTIVE – B0-30: Service Improvement through Digital Aeronautical Information Management **Performance Improvement Area 2: Globally Interoperable Systems and Data – Through Globally Interoperable System Wide Information Management**					
ASBU B0-30: Impact on Main Key Performance Areas					
	Access & Equity	**Capacity**	**Efficiency**	**Environment**	**Safety**
Applicable	N	N	N	Y	Y

ASBU B0-30: Implementation Progress	
Elements	**Implementation Status (Ground and Air)**
1. QMS for AIM	Dec.2015
2. e.TOD implementation	Dec.2016
3. WGS-84 implementation	Implemented
4. AIXM implementation	Dec.2018
5. E-AIP implementation	Dec.2015
6. Digital NOTAM	Dec. 2018

ASBU B0-30: Implementation Roadblocks/Issues				
Elements	**Implementation Area**			
	Ground System Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
1. QMS for AIM 2. e-TOD implementation 3. WGS-84 implementation 4. AIXM implementation 5. e-AIP implementation 6. Digital NOTAM	Lack of electronic Database. Lack of electronic access based on Internet protocol services.	NIL	Lack of procedures to allow airlines provide digital AIS data to on-board devices, in particular electronic flight bags (EFBs). Lack of training for AIS/AIM personnel.	NIL

ASBU B0-30: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
1. QMS for AIM	Indicator: % of States QMS Certified Supporting Metric: number of States QMS Certification
2. e-TOD implementation	Indicator: % of States e-TOD Implemented Supporting Metric: number of States with e-TOD Implemented
3. WGS-84 implementation	Indicator: % of States WGS-84 Implemented Supporting Metric: number of States with WGS-84 Implemented
4. AIXM implementation	Indicator: % of States with AIXM implemented Supporting Metric: number of States with AIXM implemented

ASBU B0-30: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
5. e-AIP implementation	Indicator: % of States with e-AIP Implemented Supporting Metric: number of States with e-AIP Implemented
6. Digital NOTAM	Indicator: % of States with Digital NOTAM Implemented Supporting Metric: number of States with Digital NOTAM Implemented

ASBU B0-30: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	**Benefits**
Access & Equity	NA
Capacity	NA
Efficiency	NA
Environment	Reduced amount of paper for promulgation of information
Safety	Reduction in the number of possible inconsistencies

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REGIONAL/NATIONAL PERFORMANCE OBJECTIVE – Module N° B0-105: Meteorological information supporting enhanced operational efficiency and safety **Performance Improvement Area 2:** **Globally Interoperable Systems and Data – Through Globally Interoperable System Wide Information Management**					
ASBU B0-105: Impact on Main Key Performance Areas (KPA)					
	Access & Equity	**Capacity**	**Efficiency**	**Environment**	**Safety**
Applicable	N	Y	Y	Y	Y

ASBU B0-05: Implementation Progress	
Elements	**Implementation Status (Ground and Air)**
1. WAFS	In process of improvement
2. IAVW	In process of improvement
3. Tropical cyclone watch	In process of improvement
4. Aerodrome warnings	In process of improvement
5. Wind shear warnings and alerts	MET provider services / 2015
6. SIGMET	MET provider services / 2015
7. QMS/MET	MET provider services / 2018

ASBU B0-105: Meteorological information supporting enhanced operational efficiency and safety				
Elements	**Implementation Area**			
	Ground System Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
1. WAFS	Connection to the AFS satellite and public Internet distribution systems	Nil	Prepare a contingency plan in case of public Internet failure	N/A
2. IAVW	Connection to the AFS satellite and public Internet distribution systems	Nil	Prepare a contingency plan in case of public Internet failure	N/A
3. Tropical cyclone watch	Connection to the AFS satellite and public Internet distribution systems	Nil	Prepare a contingency plan in case of public Internet failure	N/A

ASBU B0-105: Meteorological information supporting enhanced operational efficiency and safety				
Elements	**Implementation Area**			
	Ground System Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
4. Aerodrome warnings	Connection to the AFTN	Nil	Local arrangements for reception of aerodrome warnings	N/A
5. Wind shear warnings and alerts	Connection to the AFTN	Nil	Local arrangements for reception of wind shear warning and alerts	N/A
6. SIGMET	Connection to the AFTN	Nil	N/A	N/A
7. QMS/MET	Nil	Commitment of top management	N/A	N/A

ASBU B0-105: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
1. WAFS	Indicator: States implementation of WAFS Internet File Service (WIFS) Supporting metric: Number of States implementation of WAFS Internet File Service (WIFS)
2. IAVW	Indicator: Percentage of international aerodromes/MWOs with IAVW procedures implemented Supporting metric: Number of international aerodromes/MWOs with IAVW procedures implemented
3. Tropical cyclone watch	Indicator: Percentage of international aerodromes/MWOs with tropical cyclone watch procedures implemented Supporting metric: Number of international aerodromes/MWOs with tropical cyclone watch
4. Aerodrome warnings	Indicator: Percentage of international aerodromes/AMOs with Aerodrome warnings implemented Supporting metric: Number of international aerodromes/AMOs with Aerodrome warnings implemented
5. Wind shear warnings and alerts	Indicator: Percentage of international aerodromes/AMOs with wind shear warnings procedures implemented Supporting metric: Number of international aerodromes/AMOs with wind shear warnings and alerts implemented
6. SIGMET	Indicator: Percentage of international aerodromes/MWOs with SIGMET procedures implemented Supporting metric: Number of international aerodromes/MWOs with SIGMET procedures implemented
7. QMS/MET	Indicator: Percentage of MET Provider Sates with QMS/MET implemented Supporting metric: Number of MET Provider Sates with QMS/MET certificated

ASBU B0-105: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	**Benefits**
Access & Equity	Not applicable
Capacity	Optimized usage of airspace and aerodrome capacity due to MET support
Efficiency	Reduced arrival/departure holding time, thus reduced fuel burn due to MET support
Environment	Reduced emissions due to reduced fuel burn due to MET support
Safety	Reduced incidents/accidents in flight and at international aerodromes due to MET support.

Performance Improvement Area3:
Optimum Capacity and Flexible Flights – Through Global Collaborative ATM

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REGIONAL/NATIONAL PERFORMANCE OBJECTIVE – ASBU B0-10: Improved Operations through Enhanced En-Route Trajectories **Performance Improvement Area3: Optimum Capacity and Flexible Flights – Through Global Collaborative ATM**					
ASBU B0-10: Impact on Main Key Performance Areas (KPA)					
	Access & Equity	**Capacity**	**Efficiency**	**Environment**	**Safety**
Applicable	Y	Y	Y	Y	N

ASBU B0 10: Implementation Progress	
Elements	**Implementation Status** **Air Ground**
1. Airspace planning	Dec.2018
2. Flexible Use of airspace	Dec. 2016
3. Flexible Routing	Dec. 2018

ASBU B0-10: Implementation Roadblocks/Issues				
Elements	**Implementation Area**			
	Ground system Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
1. Airspace planning	Lack of organize and manage airspace prior to the time of flight Lack of AIDC		Lack of procedures	
2. Flexible Use of airspace	NIL		Lack of implementation FUA Guidance	
3. Flexible Routing	ADS-C/CPDLC	Lack of FANS 1/A Lack of ACARS	Lack of LOAs and procedures	Poor percentage of fleet approvals

B0-10: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
1. Airspace planning	Not assigned Indicator and metrics.
2. Flexible Use of airspace	Indicator: % of time segregated airspaces are available for civil operations in the State Supporting Metric: Reduction of delays in time of civil flights.
3. Flexible Routing	Indicator: % of PBN routes implemented Supporting Metric: KG of Fuel savings Supporting Metric: Tons of CO2 reduction

ASBU B0-10: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	**Benefits**
Access & Equity	Better access to airspace by a reduction of the permanently segregated volumes of airspace.
Capacity	Flexible routing reduces potential congestion on trunk routes and at busy crossing points. The flexible use of airspace gives greater possibilities to separate flights horizontally. PBN helps to reduce route spacing and aircraft separations.
Efficiency	In particular the module will reduce flight length and related fuel burn and emissions. The module will reduce the number of flight diversions and cancellations. It will also better allow avoiding noise sensitive areas.
Environment	Fuel burn and emissions will be reduced
Safety	NA

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REGIONAL/NATIONAL PERFORMANCE OBJECTIVE – ASBU B0-35: Improved Flow Performance through Planning based on a Network-Wide view **Performance Improvement Area3:** **Optimum Capacity and Flexible Flights – Through Global Collaborative ATM**					
ASBU B0-35: Impact on Main Key Performance Areas (KPA)					
	Access & Equity	**Capacity**	**Efficiency**	**Environment**	**Safety**
Applicable	Y	Y	Y	Y	Y

ASBU B0-35: Implementation Progress	
Elements	**Implementation Status (Ground and Air)**
1. Air Traffic Flow Management	Dec. 2015

ASBU B0-35: Implementation Roadblocks/Issues				
Elements	**Implementation Area**			
	Ground System Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
1. Air Traffic Flow Management	Lack of system software for ATFM Lack of ATFM units implemented	NIL	Lack of ATFM and CDM procedures Lack of training	

ASBU B0-35: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
1. Air Traffic Flow Management	Indicator: % of implemented FMUs Support Metric: Number of States with ATFM units implemented.

ASBU B0-35: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	**Benefits**
Access & Equity	Improved Access and equity in the use of airspace or aerodrome by avoiding disruption of air traffic. ATFM processes take care of equitable distribution of delays
Capacity	Better utilization of available capacity, ability to anticipate difficult situations and mitigate them in advance
Efficiency	Reduced fuel burn due to better anticipation of flow issues; Reduced block times and times with engines on
Environment	Reduced fuel burn as delays are absorbed on the ground, with shut engines; or at optimum flight levels through speed or route management
Safety	Reduced occurrences of undesired sector overloads

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REGIONAL/NATIONAL PERFORMANCE OBJECTIVE – ASBU B0-84: Initial capability for ground surveillance **Performance Improvement Area3: Optimum Capacity and Flexible Flights – Through Global Collaborative ATM**					
ASBU B0-84: Impact on Main Key Performance Areas (KPA)					
	Access & Equity	**Capacity**	**Efficiency**	**Environment**	**Safety**
Applicable	N	Y	N	N	Y

ASBU B0-84: Implementation Progress	
Elements	**Implementation Status (Air Ground)**
1. Implementation of ADS B	June 2018 Users and service provider
2. Implementation of Multilateration	June 2018 Users and service provider
3. Automation system (Presentation)	Dec 2017 Users and service provider

ASBU B0-84: Implementation Roadblocks/Issues				
Elements	**Implementation Area**			
	Ground System Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
1. Implementation of ADS B	Lack of ADS B systems implementation due to recent implementation of conventional surveillance systems	Lack of ADS B implementation in general aviation, and old commercial fleet	Lack of procedures	Lack of inspectors with appropriate capability
2. Implementation of multilateration	Facilities at remote stations Establishment of communications networks	NIL	NIL	Lack of inspectors with appropriate capability
3. Automation system (Presentation)	Lack of any automation functionality	NIL	NIL	NIL

B0-84: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
1. Implementation of ADS B	Indicator: Percentage of international aerodromes with ADS-B implemented Supporting metric: Number of ADS B implemented
2. Implementation of Multilateration	Indicator: Percentage of multilateration system implemented Supporting metric: Number of multilateration system implemented
3. Automation system (Presentation)	Indicator: Percentage of ATS units with automation system implemented Supporting metric: Number of automation system implemented in ATS units

ASBU B0-84: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	**Benefits**
Access & Equity	NA
Capacity	Typical separation minima are 3 NM or 5 NM enabling an increase in traffic density compared to procedural minima TMA surveillance performance improvements are achieved through high accuracy, better velocity vector and improved coverage
Efficiency	NA
Environment	NA
Safety	Reduction of the number of major incidents. Support to search and rescue

AIR NAVIGATION REPORT FORM (ANRF)

SAM Regional Planning for ASBU Modules

REGIONAL/NATIONAL PERFORMANCE OBJECTIVE – B0-101: ACAS Improvements Performance Improvement Area3: Optimum Capacity and Flexible Flights – Through Global Collaborative ATM					
ASBU B0-102: Impact on Main Key Performance Areas (KPA)					
	Access & Equity	**Capacity**	**Efficiency**	**Environment**	**Safety**
Applicable	N	N	Y	N	Y

ASBU B0-101: Implementation Progress	
Elements	**Implementation Status (Air Ground)**
1. ACAS II (TCAS Version 7.1)	

ASBU B0-101: Implementation Roadblocks/Issues				
Elements	**Implementation Area**			
	Ground System Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
1. ACAS II (TCAS Version 7.1)				

ASBU B0-101: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
1. ACAS II (TCAS Version 7.1)	

ASBU B0-101: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	**Benefits**
Access & Equity	NA
Capacity	NA
Efficiency	ACAS improvement will reduce unnecessary resolution advisory (RA) and then reduce trajectory deviations
Environment	NA
Safety	ACAS increases safety in the case of breakdown of separation

AIR NAVIGATION REPORT FORM (ANRF)

SAM Regional Planning for ASBU Modules

REGIONAL/NATIONAL PERFORMANCE OBJECTIVE – B0-102: Increased Effectiveness of Ground-Based Safety Nets **Performance Improvement Area3: Optimum Capacity and Flexible Flights – Through Global Collaborative ATM**					
ASBU B0-102: Impact on Main Key Performance Areas (KPA)					
	Access & Equity	**Capacity**	**Efficiency**	**Environment**	**Safety**
Applicable	N	N	N	N	Y

ASBU B0-102: Implementation Progress	
Elements	**Implementation Status (Air Ground)**
1. Short Term Conflict Alert (STCA)	June 2014 /Service Provider
2. Area Proximity Warning (APW)	June 2014 / Service Provider
3. Minimum Safe Altitude Warning (MSAW)	June 2014

ASBU B0-102: Implementation Roadblocks/Issues				
Elements	**Implementation Area**			
	Ground System Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
1. Short Term Conflict Alert (STCA)	NIL	NIL	NIL	NIL
2. Area Proximity Warning (APW)	NIL	NIL	NIL	NIL
3. Minimum Safe Altitude Warning (MSAW)	NIL	NIL	NIL	NIL

ASBU B0-102: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
1. Short Term Conflict Alert (STCA)	Indicator Percentage of ATS units with ground based safety nets (STCA,) implemented Metric Support Number of safety NET (STCA) implemented
2. Area Proximity Warning (APW)	Indicator Percentage of ATS units with ground based safety nets (APW) implemented Metric Support Number of safety NET (APW) implemented
3. Minimum Safe Altitude Warning (MSAW)	Indicator Percentage of ATS units with ground based safety nets (MSAW) implemented Metric Support: Number of Safety NET (MSAW)

ASBU B0-102: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	**Benefits**
Access & Equity	NA
Capacity	NA
Efficiency	NA
Environment	NA
Safety	Significant reduction of the number of major incidents

Performance Improvement Area 4:
Efficient Flight Path – Through Trajectory-based Operations

AIR NAVIGATION REPORT FORM (ANRF)

SAM Regional Planning for ASBU Modules

REGIONAL/NATIONAL PERFORMANCE OBJECTIVE – B0-05: Improved Flexibility and Efficiency in Descent Profiles (CDO) **Performance Improvement Area 4:** **Efficient Flight Path – Through Trajectory-based Operations**					
ASBU B0-05: Impact on Main Key Performance Areas (KPA)					
	Access & Equity	**Capacity**	**Efficiency**	**Environment**	**Safety**
Applicable	N	N	Y	N	Y

ASBU B0-05: Implementation Progress	
Elements	**Implementation Status (Ground and Air)**
1. CDO implementation	Dec.2017
2. PBN STARs	Dec.2017

ASBU B0-05: Implementation Roadblocks/Issues				
Elements	**Implementation Area**			
	Ground System Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
1. CDO implementaion	The ground trajectory calculation function will need to be upgraded.	CDO Function	LOAs and Training	In accordance with application requirements
2. PBN STARs	Airspace Design		LOAs and Training	

ASBU B0-05: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
1. CDO implementation	Indicator: % of International Aerodromes/TMA with CDO implemented Supporting Metric: Number of International Aerodromes/TMAs with CDO implemented
2. PBN STARs	Indicator: % of International Aerodromes/TMA with PBN STAR implemented Supporting Metric: Number of International Aerodromes/TMAs with PBN STAR implemented

ASBU B0-05: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	**Benefits**
Access & Equity	NA
Capacity	NA
Efficiency	Cost savings through reduced fuel burn. Reduction in the number of required radio transmissions
Environment	Reduced emissions as a result of reduced fuel burn
Safety	More consistent flight paths and stabilized approach paths. Reduction in the incidence of controlled flight into terrain (CFIT

AIR NAVIGATION REPORT FORM (ANRF)

SAM Regional Planning for ASBU Modules

REGIONAL PERFORMANCE OBJECTIVE – B0-20: Improved Flexibility and Efficiency Departure Profiles - Continuous Climb Operations (CCO) **Performance Improvement Area 4: Efficient Flight Path – Through Trajectory-based Operations**					
ASBU B0-20: Improved Flexibility and Efficiency in Departure Profiles (CCO)					
	Access & Equity	**Capacity**	**Efficiency**	**Environment**	**Safety**
Applicable	N	N	Y	N	N

ASBU B0-20: Implementation Progress	
Elements	**Implementation Status (Ground and Air)**
1. CCO implementation	Dec.2017
2. PBN SIDs implementation	Dec.2017

ASBU B0-20: Implementation Roadblocks/Issues				
Elements	**Implementation Area**			
	Ground System Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
1. CCO implementation			LOAs and Training	In accordance with application requirements
2. PBN SIDs implementation	Airspace Design		LOAs and Training	

ASBU B0-20: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
1. CCO implementation	Indicator: Percentage of international aerodromes with CCO implemented Supporting metric: Number of international airport with CCO implemented
2. PBN SIDs implementation	Indicator: Percentage of international aerodromes with PBN SIDs implemented Supporting metric: Number of international airport with PBN SIDs implemented

ASBU B0-20: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	**Benefits**
Access & Equity	
Capacity	
Efficiency	Cost savings through reduced fuel burn and efficient aircraft operating profiles. Reduction in the number of required radio transmissions
Environment	Authorization of operations where noise limitations would otherwise result in operations being curtailed or restricted. Environmental benefits through reduced emissions
Safety	More consistent flight paths. Reduction in the number of required radio transmissions. Lower pilot and air traffic control workload

AIR NAVIGATION REPORT FORM (ANRF)

SAM Regional Planning for ASBU Modules

REGIONAL/NATIONAL PERFORMANCE OBJECTIVE – B0-40: Improved Safety and Efficiency through the initial application of Data Link En-Route **Performance Improvement Area4: Efficient Flight Path – Through Trajectory-based Operations**					
ASBU B0-40: Impact on Main Key Performance Areas (KPA)					
	Access & Equity	**Capacity**	**Efficiency**	**Environment**	**Safety**
Applicable	N	Y	Y	Y	Y

ASBU B0-40: Implementation Progress	
Elements	**Implementation Status (Ground and Air)**
1. ADS-C over oceanic and remote areas	June 2018 Service provider
2. Continental CPDLC	June 2018 Service provider

ASBU B0-40: Implementation Roadblocks/Issues				
Elements	**Implementation Area**			
	Ground System Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
1. ADS-C over oceanic and remote areas	NIL	Implementation of ADS general aviation pending	Implementation of GOLD procedures pending	Lack of duly trained inspectors for approval of operations
2. Continental CPDLC	NIL	Implementation of CPDLC general aviation pending	Implementation of GOLD procedures pending	Lack of duly trained inspectors for approval of operations

ASBU B0-05: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
1. ADS-C over oceanic and remote areas	Indicators: Percentage of FIRs with ADS C implemented Supporting metric: Number of ADS C approved procedures over oceanic and remote areas
2. Continental CPDLC	Indicators: Percentage of CPDLC implemented at oceanic and remote area FIRs Supporting metric: Number of CPDLC approved procedures over oceanic and remote areas

ASBU B0-35: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	**Benefits**
Access & Equity	NA
Capacity	A better localization of traffic and reduced separation allow increased capacity. Reduced communication workload and better organization of controller tasks allowing increasing sector capacity.
Efficiency	Routes/tracks and flights can be separated by reduced minima, allowing to apply flexible routings and vertical profiles closer to the user-preferred ones
Environment	Reduced emissions as a result of reduced fuel burn
Safety	ADS-C based safety nets supports cleared level adherence monitoring, route adherence monitoring, danger area infringement warning and improved search and rescue. Reduced occurrences of misunderstandings; solution to stuck microphone situations.

ATTACHMENT F

GLOSSARY OF ACRONYMS

ABAS	Aircraft-based augmentation system
ACC	Area control centre
ADS	Automatic dependence surveillance
ADS-B	ADS-broadcast
ADS-C	ADS-contract
AFTN	Aeronautical fixed telecommunication network
AGA	Aerodromes and ground aids
AIDC	ATS inter-facility data communication
AIM	Aeronautical information management
AIRAC	Aeronautical information regulation and control
AIS	Aeronautical information service
AIXM	Aeronautical information exchange model
AMHS	ATS message handling system
ANP	Regional air navigation plan
ANS	Air navigation services
ANSP	Air navigation service provider
AO	Aerodrome operations
AOM	Airspace organisation and management
AOP	Aerodrome operations
APP	Approach control office or service
A-SMGCS	Advanced surface movement guidance and control system
ASBU	Aviation System Block Upgrades
ATC	Air traffic control
ATFM	Air traffic flow management
ATM	Air traffic management
ATMCP	Air traffic management operational concept panel
ATM SDM	ATM service delivery management
ATN	Aeronautical telecommunication network
ATS	Air traffic services
AUO	Airspace user operations
AWOS	Automated Weather Observing Systems
CAR / SAM	Caribbean and South American Regions
CDO	Continuous descent operations
CFIT	Controlled flight into terrain
CATC	Civil aviation training centre
CM	Conflict management
CNS	Communications, navigation and surveillance
CNS/ATM	Communications, navigation and surveillance/air traffic management
CO2	Carbon dioxide

CPDLC	Controller-pilot Data link communications
D-ATIS	Data link-automatic terminal information service
DCB	Demand/capacity balancing
DCL	Digital flight plan clearances
DME	UHF distance-measuring equipment
eAIP	Aeronautical information publication
eTOD	Terrain and obstacle database
FANS	Future air navigation systems
FASID	Regional plan facilities and services implementation document (Document 8733)
FIR	Flight information region
FL	Flight level
FMS	Flight management system
FUA	Flexible use of airspace
GIS	Geographical information system
GLS	GPS-based *landing* system
GML	Geography markup language
GNSS	Global navigation satellite system
GPI	Global Plan initiatives
GPS	Global positioning system
GPWS	Ground proximity warning system
GREPECAS	CAR/SAM regional planning and implementation group
HF	High frequencies
HFDL	HF Data link
IAVW	International Airways Volcano Watch
IFR	Instrument flight rules
ILS	Instrument landing system
IMC	Instrument meteorological conditions
ISO	International Standards Organisation
IVATF	International Volcanic Ash Task Force
KPI	Key performance indicators
LAR	Latin American aeronautical regulations
MET	Meteorological services for air navigation
METAR	Aviation routine weather report, which provides the meteorological conditions prevailing at an aerodrome.
METWSG	Meteorological Warnings Study Group
MLAT	Multilateration – Surveillance system
MSAW	Minimum safe altitude warning
MWO	Meteorological Watch Office
NDB	Non-directional radio beacon
NGAP	New generation of aviation professionals
NM	Nautical miles
NPA	Non-precision approach
NOTAM	Notice to personnel concerned with flight operations

ICAO	International Civil Aviation Organization
OLDI	Direct data interchange
OMA	Automatic weather office
WMO	World Meteorological Organization
OPMET	Operational meteorological information
PDC	Predeparture clearance
PFF	Performance Framework Form
PIRG	Planning and implementation regional group
PSR	Primary surveillance radar
QMS	Quality management system
RASG-PA	Regional aviation safety group - Pan-American
REDDIG	South American digital communication network
RNAV	Area navigation
RNP	Required navigation performance
RVR	Runway visual range
RVSM	Reduced vertical separation minimum
SADIS	Satellite distribution system for information relating to air navigation
SAM	South American Region
SARPS	Standards and recommended practices
SID	Standard instrument departure
SIGMET	Significant weather
SLA	Service level agreement
AMSS	Aeronautical mobile-satellite service
SMGCS	Surface movement guidance and control system
SPECI	Special aviation weather report
SSR	Secondary surveillance radar
STAR	Standard instrument arrival
TMA	Terminal control area
TRA	Temporary reservation of airspace
TS	Traffic synchronisation
TWR	Aerodrome control tower or aerodrome control
UAS	Unmanned aircraft systems
VDL	VHF digital Relation-ship
VFR	Visual flight rules
VHF	Very high frequency
VOLMET	Meteorological information for aircraft in flight
VOR	VHF omnidirectional radio range
WAFS	World area forecast system
WATRS	Western Atlantic route system
WGS-84	World geodetic system — 1984
XML	Extensible markup language

ATTACHMENT G

AERONAUTICAL METEOROLOGICAL INFORMATION (MET) PROVIDED BAND MET UNITS

.0	*Distributor*	*Destiny*	*Frequency Hour (h)*	*Communication Means*	*Flight phase*
METAR and METREPORT with TR*in (FASID Table MET 1A)	AMS	TWR, APP, ACC, FIC, COM Station	Each hour	AFTN / Intranet / CCTV, etc.	F1,F2;F3,F4 and F5
SPECI and SPECIAL with TR*in (FASID Table MET 1A)	AMS	TWR, APP, ACC, FIC, COM Station	Each hour	AFTN / Intranet / CCTV, etc.	F1,F2;F3,F4 and F5
TAF	AMO	TWR, APP, ACC, FIC, COM Station	Each hour	AFTN / Intranet / CCTV, etc.	F1,F2;F3,F4 and F5
Aerodrome warnings	AMO	TWR, APP, COM Station, AGA Services	When justified	AFTN / Intranet / CCTV, etc.	F1,F2,F4 and F5
WINTEM (data obtained of WAFS)	AMO and/or MWO	ACC, FIC	Every 6h (if justified)	AFTN / Intranet / CCTV, etc.	F3
Significant weather forecast in (data obtained of WAFS)	AMO and/or MWO	ACC, FIC	Every 6h (if justified)	AFTN / Intranet / CCTV, etc.	F3
SIGMET	AMO and/or MWO	ACC, FIC	Every 6h (if justified)	AFTN / Intranet / CCTV, etc.	F3
Wind shear warnings and alerts	AMO	TWR and APP	When justified	AFTN / Intranet / CCTV, etc.	F1,F2,F4 and F5
Tropical cyclones advisories	AMO	TWR and APP	When justified	AFTN / Intranet / CCTV, etc.	F1,F2,F4 and F5
Volcanic ash advisories	TCA/MWO	ACC AND FIC	When justified	AFTN / Intranet / CCTV, etc.	F3
Information on accidental release of radioactive materials, that means the location of the accident and projected trajectories of the radioactive material.	MWO (normally the information is obtained from the RMSC of the MWO involved)	ACC AND FIC	When justified	AFTN / Intranet / CCTV, etc.	F3
Information on volcanic eruptions and volcanic ash on which no SIGMET has been issued yet	MWO/VAAC	ACC AND FIC	When justified	AFTN / Intranet / CCTV, etc.	F3

Phase 1: Take-Off
Phase 2: Departure
Phase 3: En route
Phase 4: Approach
Phase 5: Landing

* Prepared by the AMO

ATTACHMENT H

REFERENCE DOCUMENTS

- ICAO Document 7192 -AN/857: Training Manual
- ICAO Document 8126 “Aeronautical Information Services Manual”
- ICAO Document 8697 “Aeronautical Chart Manual”
- ICAO Document 8733: CAR/SAM Regional Air Navigation Plan
- ICAO Document 8896: Manual of aeronautical meteorological practice
- ICAO Document 9137. Airport Services Manual.
- ICAO Document 9157. Aerodrome Design Manual
- ICAO Document 9184. Airport Planning Manual.
- ICAO Document 9377: Manual on coordination between air traffic services, aeronautical information services and aeronautical meteorological services
- ICAO Document 9674 “World Geodetic System (WGS-84) Manual”.
- IMO/ICAO Doc 9731 – International Manual of Search and Rescue Aeronautical and Maritime Services
- ICAO Document 9750: Global Air Navigation Plan
- ICAO Document 9774: Aerodrome Certification Manual.
- ICAO Document 9828: Eleventh Air Navigation Conference
- ICAO Document 9830. Surface Movement Guidance and Control Systems (SMGCS) Manual
- ICAO Document 9854: Global ATM Operational Concept
- ICAO Document 9859. Safety Management Manual.
- ICAO Document 9868: Training (PANS)
- ICAO Document 9882: Manual on ATM Requirements
- ICAO Document 9883: Manual on global performance of the air navigation system
- ICAO Document 9931: Manual on Continuous Descent Operations
- ICAO Annex 2 – Rules of the Air
- ICAO Annex 3 - Meteorological service for international air navigation.
- ICAO Annex 4 - “Aeronautical Charts”
- ICAO Annex 10, Volumes I to V
- ICAO Annex 11, Air Traffic Services
- ICAO Annex 12, Search and Rescue Services
- ICAO Annex 14, Standards and Recommended Practices - SARPS
- ICAO Annex 15 – “Aeronautical Information Service”
- ICAO Electronic Bulletin EB2010/40 of 28 September 2010 “ ICAO Civil Aviation Training Policy”
- Circular 311
- Circular 330
- WMO Bulletin No. 258, Supplement No. 1 – Training and qualification requirements for aeronautical meteorological personnel
- CAR/SAM PBN Roadmap, version 1.4 / July 2009;
- GNSS Manual, Doc 9849 AN/457;
- Air Traffic Flow Management Operational Concept for the Caribbean and South American Regions (CAR/SAM ATFM CONOPS)
- Roadmap SAM Roadmap for Air Traffic Flow Management

- Guidelines for the transition to satellite navigation systems in the CAR/SAM Regions (Appendix H to Document 8733)
- Strategies for the introduction and application of non-visual aids in approach, landing and departure in the CAR/SAM Regions (Appendix I to Document 8733)
- Caribbean/South American Air Traffic Flow Management Manual
- Manual on the Collaborative Decision-Making Process for the South American Region
- Guide for the application of a common methodology to estimate airport and ATC sector capacity for the SAM Region
- Programme for optimising the ATS route network in the South American Region
- CAR/SAM Roadmap for Performance-Based Navigation
- PBN implementation Project – En-route operations – Short term – SAM Region
- PBN Implementation Project – TMA and Approach Operations – Short Term – SAM Region.
- GNSS Manual, Doc 9849 AN/457
- GREPECAS /14 final report (April 2007)
- Strategy for the evolution of air navigation systems in the CAR/SAM Regions - First Edition Rev. 2.0 – CNS/ATM/SG/1
- GREPECAS/14 Final Report
- CAR/SAM regional unified surveillance strategy - CNS/ATM/SG/1
- Guidance for improving communication, navigation and surveillance systems to meet short- and medium-term operational requirements for en-route and terminal area operations – Regional Project RLA/06/901- October 2008
- Guideline for the implementation of national IP digital networks in support of current and future aeronautical applications (RLA/06/901 project)
- Guide for the operational interconnection of AMHS systems in the SAM Region (RLA/06/901 project)
- Model Memorandum of Understanding (MoU) for the interconnection of AMHS (RLA/06/901 project)
- Plan for the interconnection of automated ACC in the CAR/SAM Regions (RLA/06/901 project)
- Preliminary system interface control document for the interconnection of ACC centers of the CAR/SAM Regions (RLA/98/003 project)
- Preliminary reference system/subsystem specification for the air traffic control automation system (SSS) (Project RLA/06/901)
- Model Memorandum of Understanding (MoU) for the interconnection of automated systems (RLA/06/901 project)
- 37th Session of the Assembly, Working Paper A37-WP/ 64: Report on outcomes of initiatives regarding Next Generation of Aviation Professionals
- FANS 1/1 Operations Manual – FOM
- Global Operational Data Link Document (GOLD).
- *http://www2.icao.int/en/anb/met-aim/met/sadisopsg/Pages/default.aspx*
- *http://www.metoffice.gov.uk/sadis/index.html*
- *http://www2.icao.int/en/anb/met-aim/met/wafsopsg/Pages/default.aspx*
- *http://www2.icao.int/en/anb/met-aim/met/metwsg/Pages/HomePage.aspx*
- *http://www2.icao.int/en/anb/met-aim/met/iavwopsg/Pages/HomePage.aspx*
- *http://www2.icao.int/en/anb/met-aim/met/ivatf*
- "AIS-AIM Transition Roadmap" – ICAO
- Report of the seventh meeting of the AGA/AOP/SG7 Subgroup, Buenos Aires, Argentina, 9 to 13 September 2009.
- SESAR HP in the Single European Sky ATM Research Programme.