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

FOLLOW UP ON THE ACTIVITIES OF PROJECT D2 – ATN GROUND-GOUND AND AIR-GROUND APPLICATIONS IN THE SAM REGION

(Presented by the Project Coordinator)

SUMMARY

This working paper shows the progress made in the activities of the ground-ground and ground-air communication infrastructure programme.

REFERENCE

- Twelfth Air Navigation Conference (Montreal, Canada, 19-30 November 2012);
- Sixth meeting of RLA/06/901 Project Coordination Committee (RCC/6) (Lima, Peru, 21-23 November 2012);
- SAM/IG/10 meeting report (Lima, Peru, 1-5 october 2012); and
- Seminar/workshop on the implmentation of ground-ground and ground-air in the SAM Region (Lima, Peru, 10-12 September 2012).

ICAO strategic objectives:	*A – Safety* *C – Environmental protection and sustainable development of air transport*

1. Introduction

1.1 The GREPECAS Ground-Ground/Air-Ground Communication Infrastructure Programme for the SAM Region contemplates two projects: the SAM ATN architecture project *(*Project D1*),* and the ATN ground-ground and air-ground applications project (Project D2).

1.2 Since the SAM/IG/10 meeting to date, progress has been made in the implementation of the activities envisaged in these Projects; information on the progress made is shown in this working paper.

1.3 Many of the activities carried out have been possible thanks to the support provided by Projects RLA/03/901 - *REDDIG Management and Satellite Segment Administration System* and RLA/06/901 - *Assistance for the implementation of a regional ATM system, taking into account the ATM operational concept and the corresponding technological support for communications, navigation, and surveillance (CNS).*

2. **Discussion**

Project D2 – *SAM ATN ground-ground and air-ground applications*

2.1 The activities envisaged in this Project are summarized in the following aspects: Operational integration of international AMHS connections in the SAM Region; operational integration of international AIDC connections in the SAM Region; and drafting of guidelines for AIDC implementation and for the implementation of ground-air data link applications. **Appendix A** describes Project D2.

Operational integration of AMHS connections

2.2 The status of implementation of AMHS and AMHS systems interconnection is shown in **Appendices B** and **C**.

2.3 In order to support the interconnection of AMHS systems in the SAM Region, the holding of a new *Course on ATS Message Handling System (COM-AMHS) and Interconnection Aspects* was approved (to be held in Lima, Peru, from 24 to 28 June 2013) thanks to the support of Project RLA/03/901. The course was prepared by the EUROCONTROL Instilux Institute and will be conducted by an expert with broad experience in AMHS systems and communication networks.

2.4 The purpose of the course was to provide information on the technical design of an AMHS system (data networks, server topology, user configuration, routing tables, monitoring and supervision tools, interconnection with other AMHS systems, etc.) and on operational issues such as the design of an appropriate addressing and routing policy, strategies for migrating AFTN flows from AFTN to AMHS, with special attention on contents related to the interconnection between the AMHS system and the operational procedures for incident resolution and escalation. Thirty-four participants of 12 SAM States attended the course.

2.5 It is expected that at the end of the Course, the participants will have deepened their knowledge on AMHS, acquiring the information necessary to facilitate the interoperability of the AMHS installed in the Region..

Operational integration of AIDC connections

2.6 This activity is being coordinated under Project C1 of the Automation Programme. In this regard, Project D2 is providing support with the drafting of a *Guide for the implementation of AIDC,* with the view to reducing coordination errors. This includes a revision of the Interface Control Document (ICD) for data communications between ATS units in the Caribbean and South American Regions, approved through GREPECAS Conclusion 14/43.

2.7 The guide for the use of AIDC is an important tool to promote AIDC implementation and to determine the types of AIDC messages to be used and their operational acceptance, so that they may be included in the letters of agreement between ATS units that will exchange the data.

2.8 The guideline was prepared in April 2013, thanks to the support of RLA/06/901 project, which enabled that CNS and ATM experts from Argentina to draft the preliminary guide shown in Appendix D for the discussion and review of the Ad-hoc Group during this SAM/IG/11 meeting.

Drafting of guidelines for the implementation of ground-air data link applications

2.9 The guide for the establishment of ground-air data links in the SAM Region is scheduled to be completed in October 2013. RLA/06/901 RCC/6 meeting (Lima, 21-23 November 2012) approved the conduct of a CNS expert mission for its drafting.

Alignment of Project activities with ASBU

1.1 In the Project's description (Appendix A), the deliverables have been related with the ASBU Block 0 modules, which will be part of the new Global Air Navigation Plan, 4th Edition (GANP) (Doc 9750) in accordance with the Twelfth Air Navigation Conference decisions.

3. **Suggested action**

3.1 The Meeting is invited to:

a) take note of the information contained herein;
b) review the progress made in programme activities shown in Section 2 of this working paper and in Appendices A, B, C and D; and
c) discuss any other aspect related to this matter as it may deem appropriate.

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APPENDIX A

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 B / APENDICE B

STATUS OF AMHS IMPLEMENTATION IN THE SAM REGION / ESTADO IMPLANTACION AMHS EN LA REGION SAM

STATE/ ESTADO	MANUFACTURER/ FABRICANTE	YEAR OF INSTALLATION/ AÑÓ INSTALACION	REMARKS / OBSERVACIONES
ARGENTINA	RADIOCOM	DEC 2005	Three MTAs installed: Ezeiza, Cordiba and Comodoro Rivadavia. Connected by P1 with Asuncion (Paraguay) since March 2012. Se tienen instalados 3 MTA: Ezeiza, Córdoba y Comodoro Rivadavia. Conectado por P1 con Asunción (Paraguay) desde marzo 2012.
BOLIVIA	THALES	DEC 2011	Equipment installed at the end of 2011 Equipos instalados a finales del 2011
BRASIL	RADIOCOM	JUN 2009	Two MTAs installed: Brazilia and Manaos Se tienen instalados dos MTA: Brasilia y Manaos
CHILE	THALES	JUN 2010	AMHS was completed at the end of 2010 El sistema AMHS se completó a finales del 2010
COLOMBIA	COMSOFT	DEC 2009	AMHS interconnected with Peru. First AMHS interconnection in the CAR/SAM Regions Está interconectado con el AMHS con Perú. Primera interconexión AMHS en las Regiones CAR/SAM
ECUADOR	THALES	FEB 2012	In July 2012, AMHS Ecuador interconnected with Peru AMHS, first interconnection between two diferent manufacturers. En julio de 2012, el AMHS de Ecuador se interconecta con el AMHS de Perú, la primera interconexión con dos empresas diferentes
GUYANA	SKYCOM	2011	Está interconectado en AMHS con Surinam con protocolo P1
FRENCH GUIANA (FRANCE)			AFTN V17 was carried out in June 2012. No AMHS available La versión V17 AFTN se realizó en junio de 2012. No dispone de AMHS
PANAMA	COCESNA THALES	End/Finales 2013	Panama approved the purchasing of a new Thales AMHS to become operational at the end of the first quarter of 2013 Panamá aprobó la adquisición de un nuevo sistema AMHS de la marca Thales que estará en operación a finales del primer trimestre de 2013

STATE/ ESTADO	MANUFACTURER/ FABRICANTE	YEAR OF INSTALLATION/ AÑÓ INSTALACION	REMARKS / OBSERVACIONES
PARAGUAY	RADIOCOM	2007	Ezeiza MTA connected with P1 protocol with the Asuncion MTA (March 2012) MTA Ezeiza conectado con Protocolo P1 con el MTA de Asunción (marzo 2012)
PERU	COMSOFT	JUN 2009	Interconnected with the Colombia AMHS since November 2013 (first AMHS interconnection in the CAR/SAM Regions) and since July 2012 with Ecuador AMHS (first interconnection with two different manufacturers) Está interconectado con el AMHS con Colombia desde noviembre de 2010 (primera interconexión AMHS en las Regiones CAR/SAM) y desde Julio 2012 con AMHS Ecuador (primera interconexión con dos empresas diferentes).
SURINAM	SKYCOM	2011	Interconnected with Guyana Interconectado con Guyana
URUGUAY		End/Finales 2013	Currently counts with an AFTN system. Is in process of purchasing an AMHS. Actualmente dispone de un sistema AFTN Se encuentra en el proceso de adquisición de un sistema AMHS
VENEZUELA	RADIOCOM	2010	AMHS installed since the end of 2010 Sistema AMHS instalado desde finales del 2010

APPENDIX C

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) Mar 2013 m) TBD n) TBD o) TBD p) TBD r) TBD s) TBD t) TBD u) TBD w) Mar 2013 x) Mar 2013 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) Dec 2012 d) Oct 2010 Completed e) Mar 2013 f) Dec 2012 g) Dec 2012 h) Jun 2011 Completed i) Jul 2012 Completed j) Dec 2012 k) Feb 2013
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) Dec 2012 c) TBD d) Dec 2012 e) Dec 2012 f) Dec 2012 g) Nov 2010 Operational h) Jul 2011 Operational i) Jul 2012 Operational j) Mar 2013 k) Mar 2013

APPENDIX D

International Civil Aviation Organization

SAM Region

GUIDE FOR THE IMPLEMENTATION

OF AIDC

THROUGH THE INTERCONNECTION

OF

ADJACENT AUTOMATED CENTRES

Lima, Peru – April 2013

TABLE OF CONTENTS

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 2013).

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:

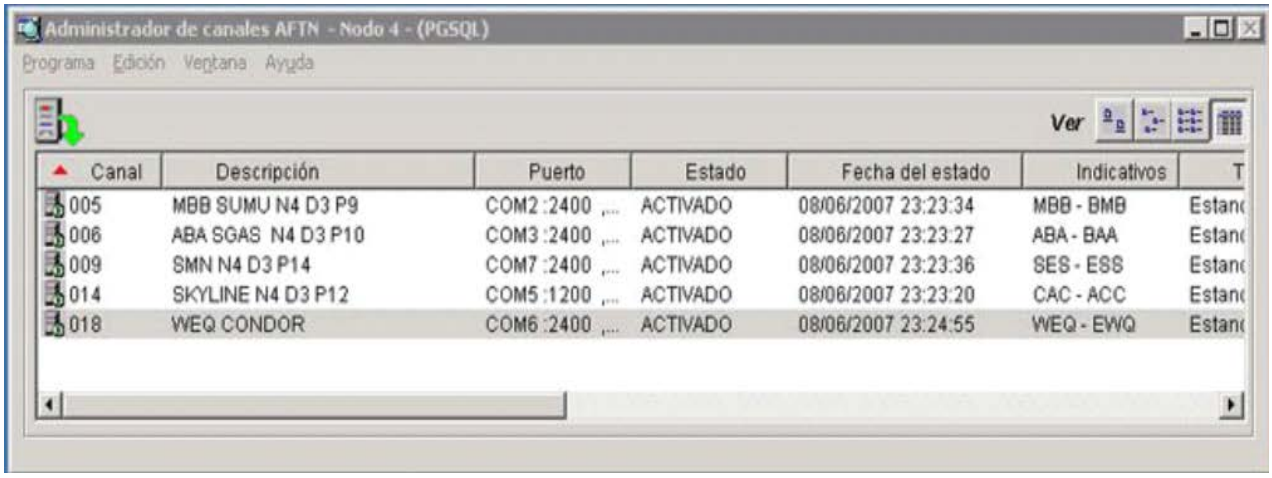
In the case of AFTN and AMHS, *"these are AFTN messages generated/received by automated systems, which travel over the respective AFTN or AMHS systems (or a combination of both). Accordingly, the increase in the amount of information will only result as an increase in the number of AFTN messages circulating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

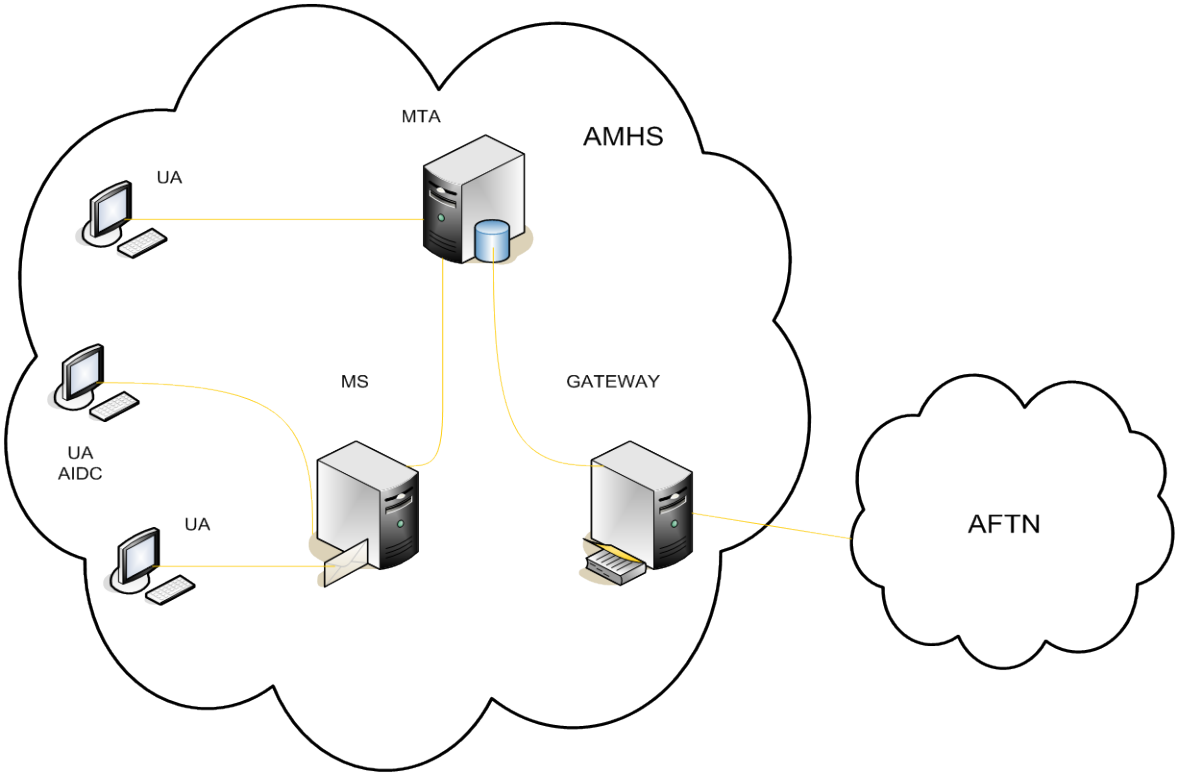
2.2.7. This ICD mainly refers to the implementation of AIDC based on AMHS and AFTN systems.

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*.



Canal	Descripción	Puerto	Estado	Fecha del estado	Indicativos	T
005	MBB SUMU N4 D3 P9	COM2 :2400 ,...	ACTIVADO	08/06/2007 23:23:34	MBB - BMB	Estan
006	ABA SGAS N4 D3 P10	COM3 :2400 ,...	ACTIVADO	08/06/2007 23:23:27	ABA - BAA	Estan
009	SMN N4 D3 P14	COM7 :2400 ,...	ACTIVADO	08/06/2007 23:23:36	SES - ESS	Estan
014	SKYLINE N4 D3 P12	COM5 :1200 ,...	ACTIVADO	08/06/2007 23:23:20	CAC - ACC	Estan
018	WEQ CONDOR	COM6 :2400 ,...	ACTIVADO	08/06/2007 23:24:55	WEQ - EWQ	Estan

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.

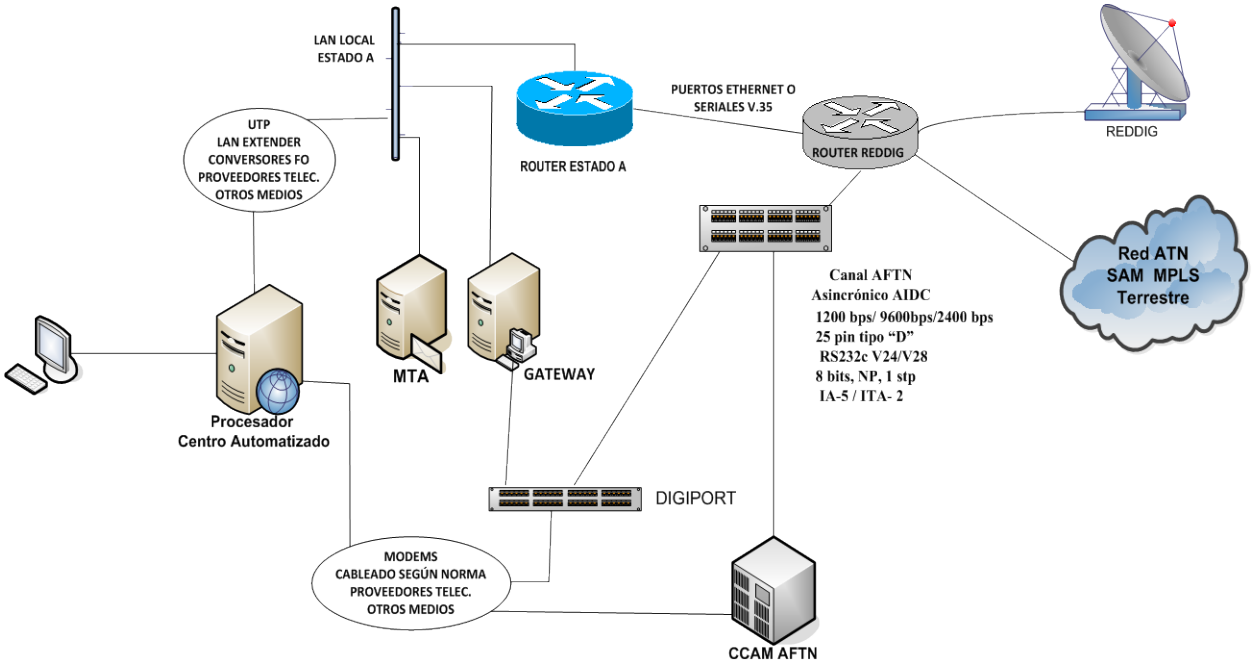
2.4.3. It is important to note that, for purposes of the implementation, the States must identify the focal points (coordinators) to be responsible for coordinating the respective work teams to be established as required (that is, technical, operational or technical-operational teams).

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. In this regard, **Appendix A** contains a model Memorandum of Understanding based on the model Memorandum of Understanding for Automated Systems.

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.

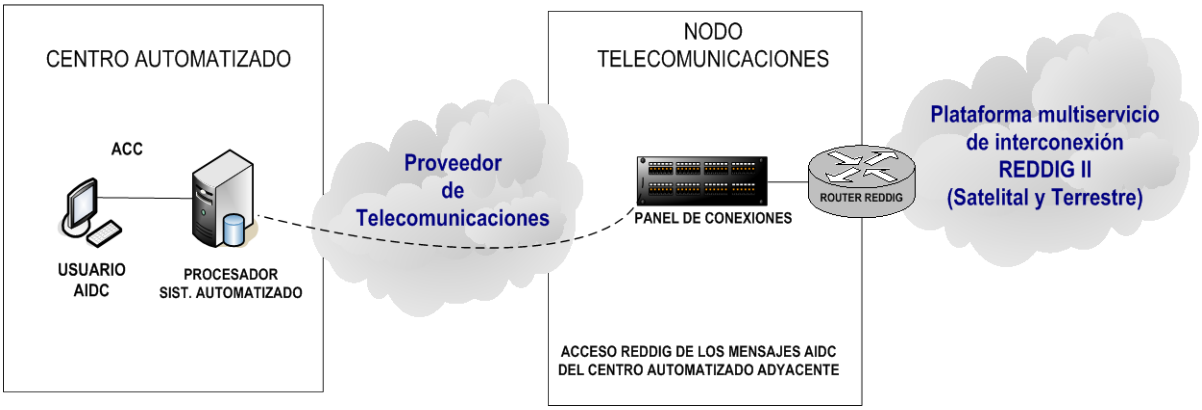


Graph 4 – Possible last-mile connectivity scenarios

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

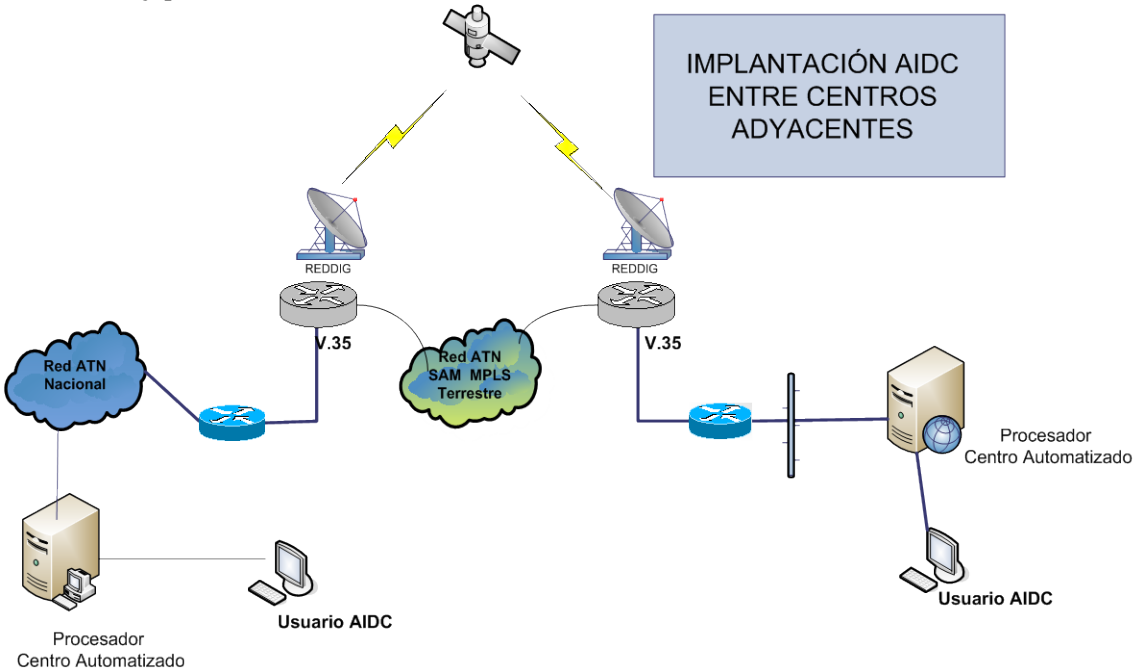
2.6. **Establish physical and logical connectivity between States**

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

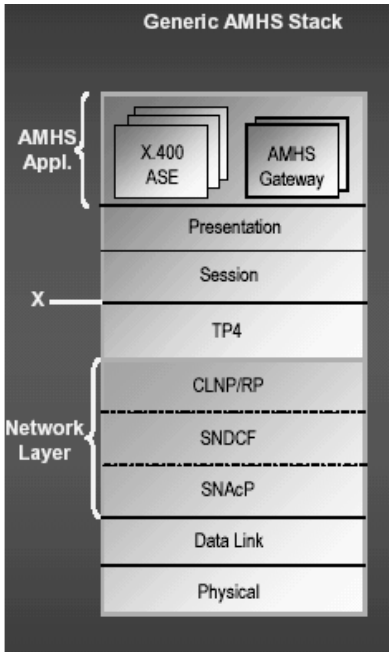
2.6.5. In this regard, the definition of connectivity adopted in the Memorandum of Understanding must be taken into account.

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 B** and **C**, 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.

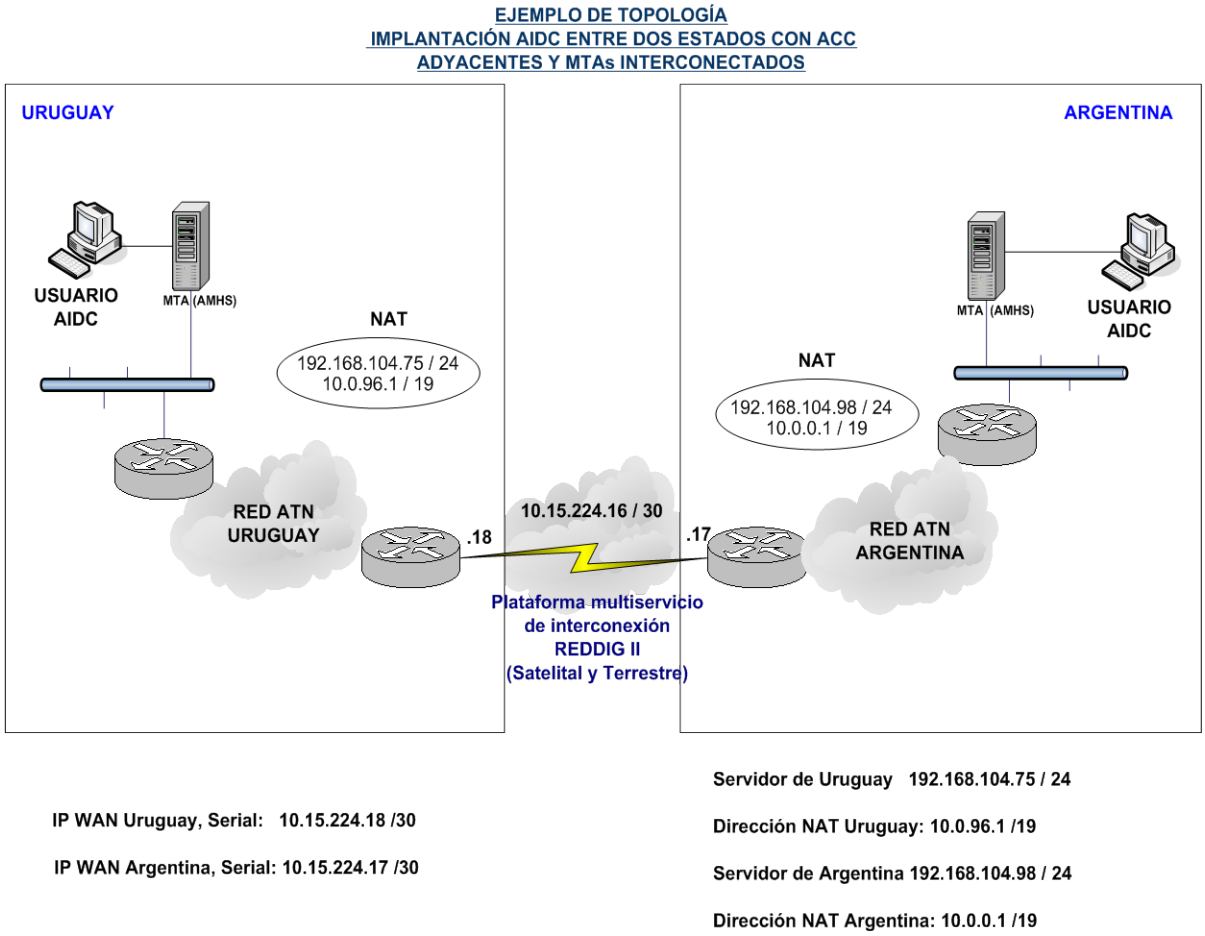
```
AMHS-RT-EZE-03#sh ip nat translations
Pro Inside global      Inside local       Outside local      Outside global
--- ---                ---                192.168.48.100     10.0.0.1
--- ---                ---                192.168.104.34     10.0.0.10
--- ---                ---                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 B), each State may use the addresses and the addressing scheme of its choice. Nevertheless, a redistribution of network segments is proposed in **Appendix D**.

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.

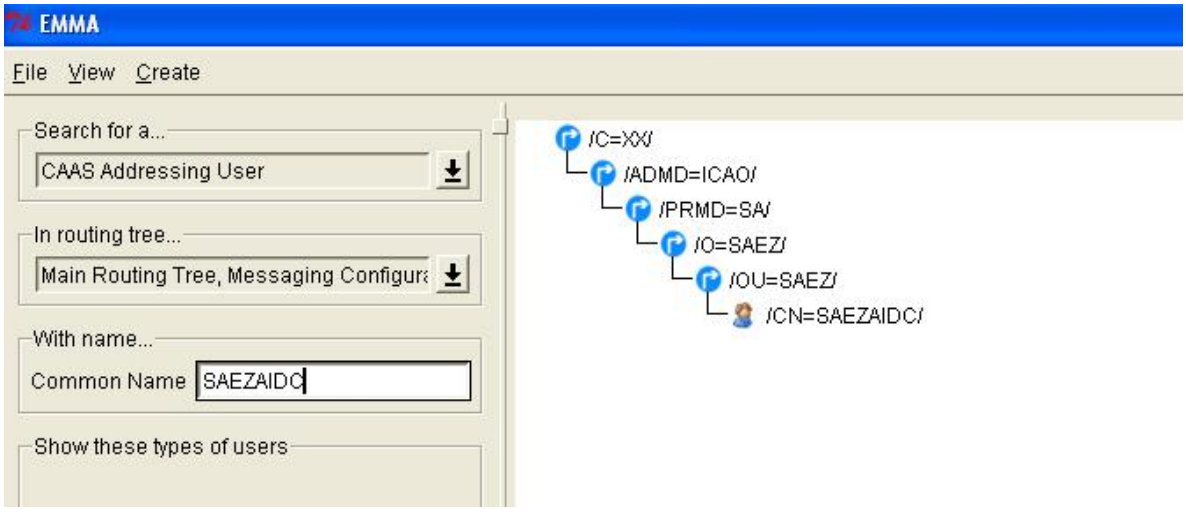
2.8.4. In order to standardise user accounts, this document proposes that the last four letters of the assigned address should be: AIDC for transmission and CADI for reception. In this manner, all the personnel of the States of the Region will readily identify that the message belongs to AIDC.

2.8.5. Example:

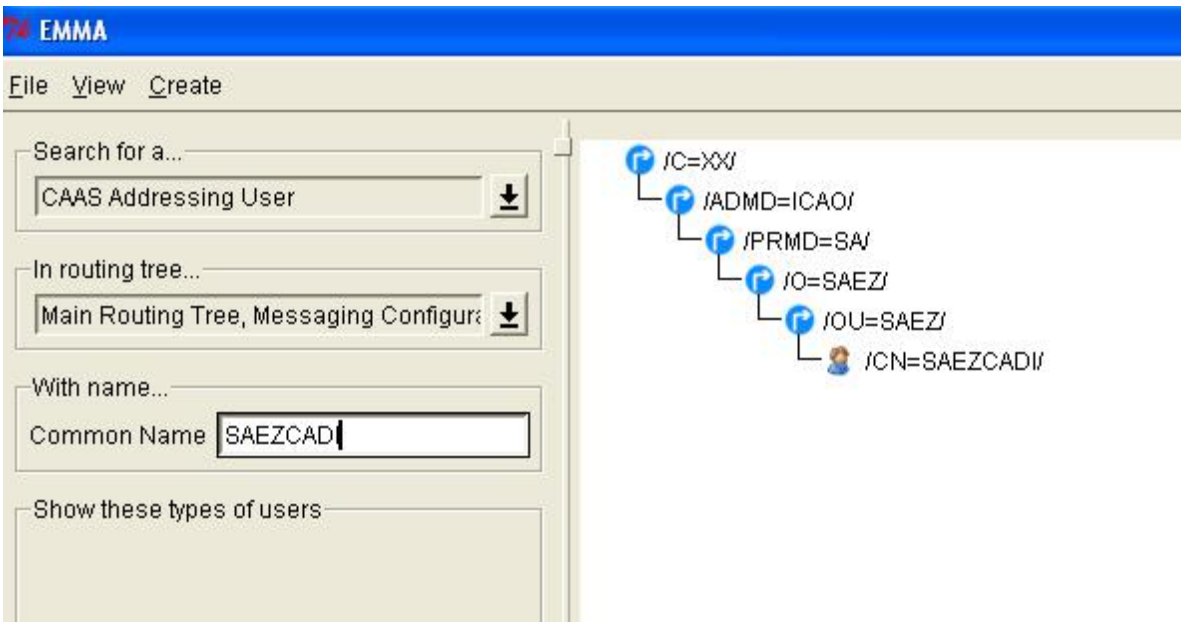
"Assuming the automated centres of Uruguay and Argentina are interconnected, the following addresses will be defined":

	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.

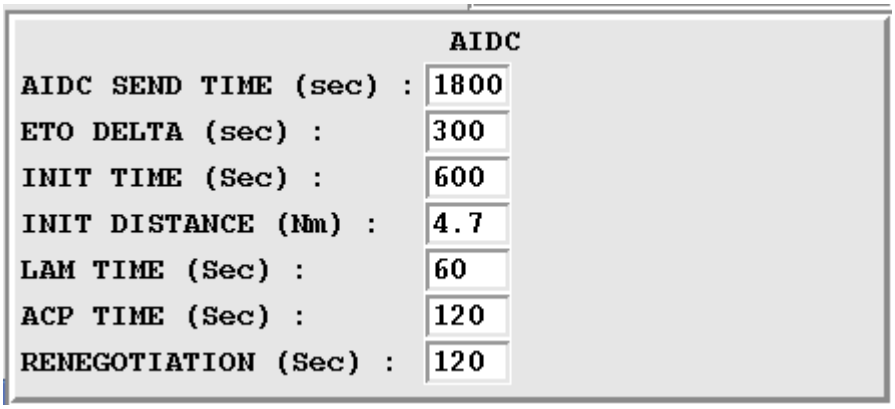
3.1.2. The notification, coordination and transfer stages will continue to be the same as those described in ICAO Doc 4444 in Chapter 10, with the difference that, when using an AIDC application, the intervention of the operator will be minimal.

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 E** 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.

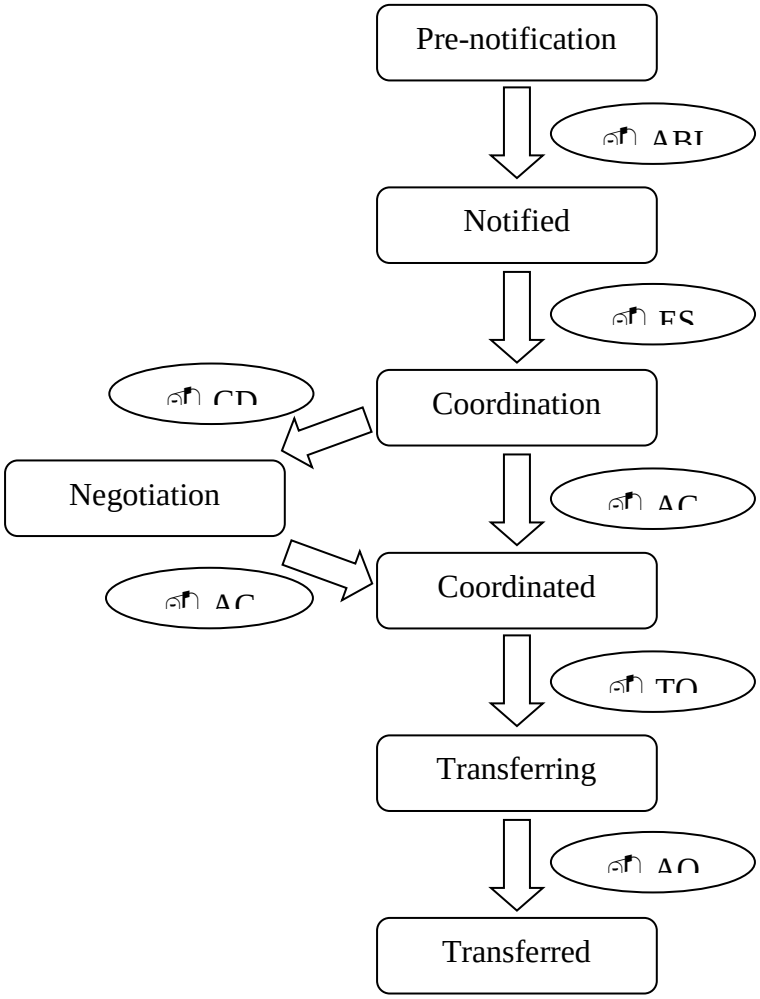
(LAM)

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.

MEMORANDUM OF UNDERSTANDING FOR AIDC IMPLEMENTATION THROUGH THE INTERCONNECTION OF ADJACENT AUTOMATED CENTRES

Preface

This document defines the Memorandum of Understanding to enable AA and BB to implement AIDC through the interconnection of their air traffic control automation systems. It is based on documents developed by ICAO automation experts and on the Memorandum of Understanding for the interconnection of automated centres.

This document may be revised by both States as necessary.

Approval

MEMORANDUM OF UNDERSTANDING FOR AIDC IMPLEMENTATION THROUGH THE INTERCONNECTION OF ADJACENT AUTOMATED CENTRES BETWEEN AA AND BB

For AA **For BB**

Revisions

Revision / Date	Description	Revised pages
Rev. 0		

TABLE OF CONTENTS

1. Section 1 – Introduction and Purpose

1.1. Introduction

Taking into account the impact that operational errors have on the ATC coordination loop between adjacent ACCs, the GREPECAS/15, in Conclusion 15/36, considered that "CAR/SAM States, Territories, and International Organizations should gradually implement the interface for the exchange of data between ATC units (AIDC);" and that "ICAO should coordinate, assist in, and follow up on, the implementation of such corrective action".

The analysis of the issue led to the conclusion that the solution involved an intense use of CNS/ATM technologies, in accordance with ICAO recommendations, especially those related to AIDC implementation through the interconnection of automated systems, as described in Document 4444- PANS/ATM, Section 8.1.6: *"States should, on the basis of regional air navigation agreements, provide for the automated exchange of coordination data relevant to aircraft being provided with ATS surveillance services, and establish automated coordination procedures"*.

In this regard, studies were conducted under Projects RLA/98/003 and RLA /06/901 in order to have a complete picture of this matter, including obstacles and required action, as well as the implementation strategy.
The documents thus produced are described in Annexes 1, 2 and 3 to the Appendix to this Memorandum.
The main body of this document has ten (10) sections and one (1) appendix. The contents of the sections and the appendix are summarised below:

a) Section 1 – Presents a brief overview and a statement of purpose;

b) Section 2 – Describes the basic principles that will guide the drafting of this document;

c) Section 3 – Lists the cases in which this Memorandum applies;

d) Section 4 – Describes the version control process;

e) Section 5 – Presents the associated legislation;

f) Section 6 – Establishes criteria and restrictions on the use of information shared by two countries;

g) Section 7 – Presents the operational aspects to be considered for AIDC implementation through the interconnection of automated systems;

h) Section 8 – Presents the technical aspects to be considered for AIDC implementation through the interconnection of automated systems;

i) Section 9 - Presents the administrative aspects to be considered for AIDC implementation through the interconnection of automated systems;

j) Section 10 - Presents the financial aspects to be considered for AIDC implementation through the interconnection of automated systems;

k) Appendix 1 – Technical-Operational Agreement

1.2. Purpose

The purpose of this MoU is to provide the planning for AIDC implementation through the interconnection of automated systems of the XXX-ACC, in AAA, and the YYY-ACC, in BBB, establishing standard procedures containing operational, technical, administrative, and financial considerations on the matter.

2. Section 2 - Principles

Upon drafting this document, the following aspects have been considered:

1. This Memorandum represents a guide for States to enter into bilateral agreements; and

2. This document takes into account the aspects contained in the documents concerning AIDC implementation through the interconnection of automated systems prepared by Projects RLA/98/003 and RLA 06/901, as well as GREPECAS recommendations and the AIDC implementation guide.

3. Section 3 - Application

This document applies only to AIDC implementation through the interconnection of automated systems between AAA and BBB.

4. Section 4 – Organization

This is a document whereby the participating States will agree, as required, to review or modify its details.
Revisions to this Memorandum, or changes to its paragraphs, will be coordinated by the participating States.

5. Section 5 - References

This Memorandum follows ICAO recommendations contained in the following documents:

a) Annex 11 to the Convention on International Civil Aviation
b) Doc 4444
c) Doc 7030
d) Doc 9426
e) Doc 9694

f) Doc 9880, Part II a (AIDC)
g) RLA/98/003 Project document
h) RLA/06/901 Project document
i) SAM/IG/1 and SAM/IG/2 final reports
j) Guide for AIDC implementation through the interconnection of automated systems

6. Section 6 - Confidentiality

Each participating State must take all the necessary measures to ensure the security, integrity and confidentiality of the information.
Disclosure of these data to other organisations not contemplated in this Memorandum will only be allowed if previously authorised by the participating States.

7. Section 7 – Operational Aspects

The application of this Memorandum may require adjustments to existing Operational Agreements between the States.
The Administrations undertake to instruct the personnel of the ACCs involved on the appropriate sections of this MoU.
The use of automated traffic transfers between automated systems through AIDC shall have priority, in accordance with the Appendix to this Memorandum of Understanding.
However, other means of communication may be used for the transfer when automatic transfer is not possible.

8. Section 8 – Technical Aspects

Section 6 of the Appendix to this Memorandum contains the technical considerations needed for the States to define the AIDC implementation scenarios, the implementation strategy, the implementation of the solution, the operational monitoring, and personnel training aspects that will best meet their needs.

9. Section 9 – Administrative Aspects

For orderly implementation of the adopted interconnection solution, the participating States agree to create an administrative structure based on an Interconnection Management Committee, whose powers, detailed composition and activities are described in Section 7 of the Appendix to this Memorandum.
The States must appoint representatives, members of their respective groups, to form the basic structure of the aforementioned Committee.
The States must choose a forum for discussing cases of non-compliance and for resolving any disputes.
This Memorandum will be applicable on a continuing basis, and may be interrupted at any time if mutually agreed by the Parties involved.
This Agreement is a dynamic document that can be revised at any time, based on the technological evolution of the automated systems and communication networks of the participating States.

The Interconnection Management Committee created by the two (2) States will have full responsibility for managing the interconnection, in accordance with the following:

1. Organisational Structure

In order to conduct its activities, the Committee will be organised as follows:

1. Coordinator

The names of the coordinators for the interconnection of systems between AAA and BBB are listed in Annex A.
The coordinators will be responsible for the general coordination of all the activities of the technical and operational groups, as well as for contacts with other organisations to address issues related to the interconnection.

2. Technical Group

This group should be made up by technicians appointed by the two States, with proven training in their areas of expertise, especially in communication networks and automation systems.
It will be responsible for the conduction and/or coordination, in their respective countries, of the technical activities required for the implementation, maintenance and AIDC support of automated systems, communication networks and interconnection equipment.

3. Operational Group

This group should be made up by air traffic experts appointed by the two States, with proven training in their areas of expertise, especially in the automated systems used in the ACCs.

2. Powers

The Committee is responsible for all coordination required for the planning, implementation, maintenance of, and support to, the operation of the systems and equipment involved in the implementation of AIDC through the interconnection of automated systems.
It shall guarantee continued security of AIDC information exchanged between the automated systems involved in the interconnection.
Its powers include the control and updating of all technical and operational documentation.
It is also responsible for the network topology project to be used in the implementation of AIDC, to be approved by the two (2) States.
The implementation of AIDC through the interconnection shall be coordinated and controlled by the Committee through action plans previously approved by the two (2) States.
The Committee must advise the States about the need for technological evolution of the equipment and systems involved in the AIDC through the interconnection.
Its teams must monitor the performance, stability, reliability, and integrity parameters of the equipment and systems involved in the interconnection, and propose and monitor corrective action.

To this end, they must use anomaly analysis tools such as radar protocol and communication line analysers.
The Committee shall establish the procedures required for correcting failures.
It shall also provide for the resolution of any issues encountered together with the participating States.

3. Management Process

In order to conduct its activities, the Interconnection Management Committee will apply the following procedures:

1. Periodic meetings and discussions to identify the requirements and preferred technical solution(s), alternatives and options for the implementation of AIDC through the interconnection of automated systems;

2. Exchange of technical reports and documentation, plans, and programmes that may be necessary to ensure successful and timely completion of these efforts.

3. Planning, technical coordination, and conduction of activities between the two (2) States.

10. Section 10 – Financial Aspects

The participating States, as individual administrations, will be responsible for any financial obligation to cover direct or indirect expenditures related to the performance of this Memorandum, including those related to the acquisition of equipment, spare parts, training of technical and operational personnel, communication lines, and others.
Each State shall be responsible for its respective share of any expenditures related to any REDDIG upgrades to address increased traffic flows, as provided for by the REDDIG Administration.
The Parties to this Memorandum understand that they shall not commit to any action that might result in a financial obligation for the other Parties without prior consent in writing from all the other parties involved.
The States may establish financial mechanisms to implement the interconnection, for instance, through ICAO Technical Cooperation Projects.

The States agree to the following with respect to financial aspects:

1. Purchase of equipment, components, and systems
The equipment needed for the implementation through the interconnection will be purchased by each State, in accordance with the technical specifications approved by the Interconnection Management Committee;

2. Purchase of the spare part set

Spare parts for the equipment involved in the interconnection for the implementation of AIDC will be acquired by each State, based on its specific needs, but in accordance with the maintenance guidelines issued by the Interconnection Management Committee.

3. Acquisition of services from third parties
Each State agrees to bear the expenses resulting from any services from third parties, such as software adjustments, projects, and communication network implementations.

11. Attachments

1. Guide for the implementation of AIDC through the interconnection of automated centres.

ANNEX A

MANAGEMENT COMMITTEE FOR THE IMPLEMENTATION OF AIDC THROUGH THE INTERCONNECTION OF AUTOMATED SYSTEMS

AA

BB

Appendix B: 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	00001010.0000.0000.00000001			
				-	-				
				-	-				
				Ultima	10 . 0 . 31 . 254	00001010.0000.0000.11111110			
	2	Chile	10.0.32.0 /19	Primera	10 . 0 . 32 . 1	00001010.0000.0010.00000001			
				-	-				
				-	-				
				Ultima	10 . 0 . 63 . 254	00001010.0000.0010.11111110			
	3	Brasil	10.0.64.0 /19	Primera	10 . 0 . 64 . 1	00001010.0000.0100.00000001			
				-	-				
				-	-				
				Ultima	10 . 0 . 95 . 254	00001010.0000.0100.11111110			
	4	Uruguay	10.0.96.0 /19	Primera	10 . 0 . 96 . 1	00001010.0000.0110.00000001			
				-	-				
				-	-				
				Ultima	10 . 0 . 127 . 254	00001010.0000.0111.11111110			
	5	Paraguay	10.0.128.0 /19	Primera	10 . 0 . 128 . 1	00001010.0000.1000.00000001			
				-	-				
				-	-				
				Ultima	10 . 0 . 159 . 254	00001010.0000.1001.11111110			
	6	Bolivia	10.0.160.0 /19	Primera	10 . 0 . 160 . 1	00001010.0000.1010.00000001			
				-	-				
				-	-				
				Ultima	10 . 0 . 191 . 254	00001010.0000.1011.11111110			
	7	Peru	10.0.192.0 /19	Primera	10 . 0 . 192 . 1	00001010.0000.1100.00000001			
				-	-				
				-	-				
				Ultima	10 . 0 . 223 . 254	00001010.0000.1101.11111110			
	8	Ecuador	10.0.224.0 /19	Primera	10 . 0 . 224 . 1	00001010.0000.1110.00000001			
				-	-				
				-	-				
				Ultima	10 . 0 . 255 . 254	00001010.0000.1111.11111110			
	9	Colombia	10.1.0.0 /19	Primera	10 . 1 . 0 . 1	00001010.0001.0000.00000001			
				-	-				
				-	-				
				Ultima	10 . 1 . 31 . 254	00001010.0001.0000.11111110			
	10	Venezuela	10.1.32.0 /19	Primera	10 . 1 . 32 . 1	00001010.0001.0010.00000001			
				-	-				
				-	-				
				Ultima	10 . 1 . 63 . 254	00001010.0001.0010.11111110			
	11	Guyana	10.1.64.0 /19	Primera	10 . 1 . 64 . 1	00001010.0001.0100.00000001			
				-	-				
				-	-				
				Ultima	10 . 1 . 95 . 254	00001010.0001.0100.11111110			
	12	Surinam	10.1.96.0 /19	Primera	10 . 1 . 96 . 1	00001010.0001.0110.00000001			
				-	-				
				-	-				
				Ultima	10 . 1 . 127 . 254	00001010.0001.0111.11111110			
	13	Guyana Francesa (France)	10.1.128.0 /19	Primera	10 . 1 . 128 . 1	00001010.0001.1000.00000001			
				-	-				
				-	-				
				Ultima	10 . 1 . 159 . 254	00001010.0001.1001.11111110			
	20	Trinidad y Tobago	10.18.96.0 /19	Primera	10 . 18 . 96 . 1	00001010.0001.0010.00000001			
				-	-				
				-	-				
				Ultima	10 . 18 . 127 . 254	00001010.0001.0010.11111110			
	-	VACANTE	10.1.160.0 /19	Primera	10 . 1 . 160 . 1	00001010.0001.1010.00000001			
				-	-				
				-	-				
				Ultima	10 . 1 . 191 . 254	00001010.0001.1011.11111110			

Appendix C: 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	
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 D

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: Asignment 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

No	State/Territory	Network	Usable Addresses	Decimal Notation
8	Ecuador	10.0.224.0 / 19	First	10.0.224.1
			-	-
			-	-
			Last	10.0.255.254
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 E

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 F

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