


**Data Transmission
and
Communication Networks**

Aeronautical Applications over IP

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**Aeronautical Applications
over IP**

- The REDDIG platform
- IP addressing plan
- GNSS – Data acquisition
- AMHS system
- Radar data exchange
- CNS/ATM integration

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The REDDIG Solution



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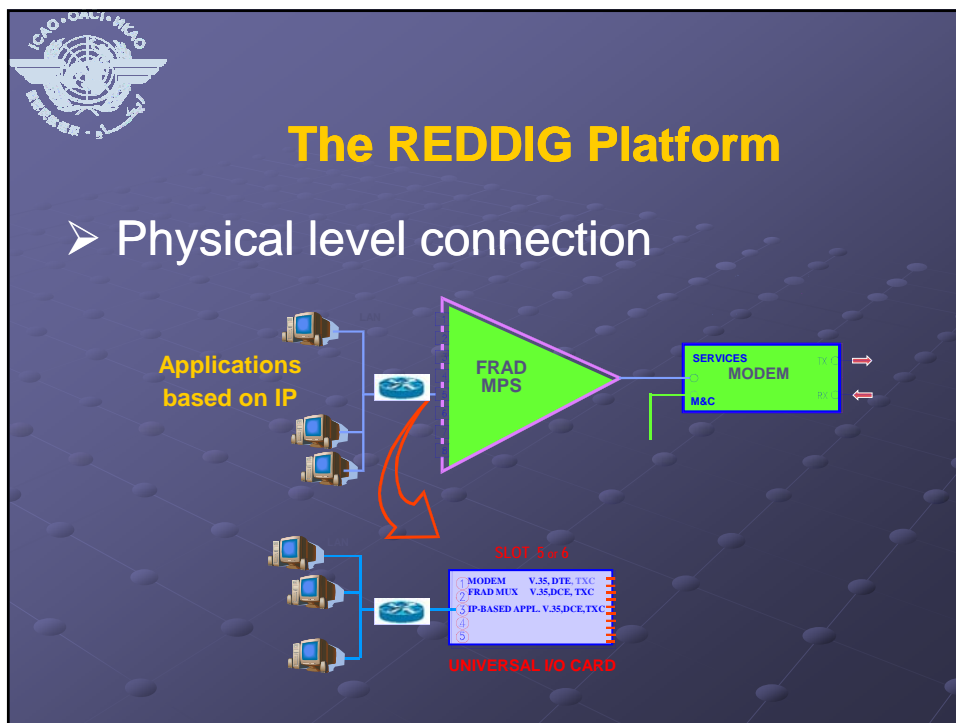
The REDDIG Platform


- BoD and 'Full Mesh' satellite technology
- Multi-protocol support: FR and IP
- Integrates voice and data aeronautical applications
- Operating since 2003 with the highest quality standards.



The REDDIG Platform

- Solution that integrates IP protocol suite-based applications
 - ✓ Using a single physical port for all applications over IP.
 - ✓ Configuring additional PVCs as required.
 - ✓ Prioritizing traffic according to the application.






IP Addressing Plan

➤ Network assignment by State/Territory

Asignación de Redes por Estado/Territorio.

Region	No.	Estado/Territorio	Red	Dimensiones utilizables	Notación Decimal	Notación Binaria		
						Region	Estado/Territorio	Hosts
NAM	1	Argentina	10.0.0.0/16	Primeras 10 0 0 1 Ultima 10 0 31 254	0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	
	2	Chile	10.0.32.0/16	Primeras 10 0 32 254 Ultima 10 0 64 254	0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	
	3	Brasil	10.0.64.0/16	Primeras 10 0 64 254 Ultima 10 0 128 254	0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	
	4	Uruguay	10.0.96.0/16	Primeras 10 0 96 254 Ultima 10 0 128 254	0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	
	5	Paraguay	10.1.128.0/16	Primeras 10 0 128 254 Ultima 10 0 192 254	0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	
	6	Bolivia	10.1.160.0/16	Primeras 10 0 160 254 Ultima 10 0 192 254	0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	
	7	Peru	10.1.192.0/16	Primeras 10 0 192 254 Ultima 10 0 255 254	0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	
	8	Ecuador	10.3.224.0/16	Primeras 10 1 0 254 Ultima 10 1 0 254	0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	
	9	Colombia	10.1.0.0/16	Primeras 10 1 0 254 Ultima 10 1 0 254	0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	
	10	Venezuela	10.1.32.0/16	Primeras 10 1 32 254 Ultima 10 1 64 254	0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	
	11	Guayana	10.1.64.0/16	Primeras 10 1 64 254 Ultima 10 1 96 254	0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	




IP Addressing Plan

➤ Network Assignment by State/Territory

Asignación de Redes por Estado/Territorio.

Region	No.	Estado/Territorio	Red	Dimensiones utilizables	Notación Decimal	Notación Binaria		
						Region	Estado/Territorio	Hosts
SAM	12	Surinam	10.1.96.0/16	Primeras 10 1 96 254 Ultima 10 1 128 254	0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	
	13	Guayana Francesa (Francia)	10.1.128.0/16	Primeras 10 1 128 254 Ultima 10 1 192 254	0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	
	-	VACANTE	10.1.160.0/16	Primeras 10 1 160 254 Ultima 10 1 192 254	0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	
	-	VACANTE	10.1.192.0/16	Primeras 10 1 192 254 Ultima 10 1 255 254	0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	
	-	VACANTE	10.1.224.0/16	Primeras 10 1 224 254 Ultima 10 1 255 254	0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	
	-	VACANTE	10.2.0.0/16	Primeras 10 2 0 254 Ultima 10 2 31 254	0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	128 (ULTIMA)	RESERVADA	10.15.224.0/16	Primeras 10 15 224 254 Ultima 10 15 255 254	0 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	




IP Addressing Plan

➤ Inter/Intra-Regional Links

Enlaces Inter/Intra Regionales correspondientes a la Región SAM

Red	Idm	Subred	Patrimonio	Enlace	
				País	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
	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
	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
	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
	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
	6	10.15.224.20 / 30	Argentina-AFI	-	10 . 15 . 224 . 20 / 30
				Argentina	10 . 15 . 224 . 21 / 30
				AFI (Madrugada)	10 . 15 . 224 . 22 / 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
	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
	9	10.15.224.32 / 30	Brasil-Guyana Francesa	-	10 . 15 . 224 . 31 / 30
				Brasil	10 . 15 . 224 . 32 / 30
				Guyana Francesa	10 . 15 . 224 . 34 / 30
	-	-	-	-	10 . 15 . 224 . 35 / 30




IP Addressing Plan

➤ Inter/Intra-Regional Links

Enlaces Inter/Intra Regionales correspondientes a la Región SAM

Red	Idm	Subred	Explotación	Enlace	
				País	Direcciones a Utilizar
10.16.221.0 / 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
	11	10.15.221.40 / 30	Brasil-Suriname	-	10 . 15 . 224 . 40 / 30
				Brasil	10 . 15 . 224 . 41 / 30
				Suriname	10 . 15 . 224 . 42 / 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
	13	10.15.224.48 / 30	Brasil-AFI (tentativo)	-	10 . 15 . 224 . 48 / 30
				Brasil	10 . 15 . 224 . 49 / 30
				AFI (Salazar)	10 . 15 . 224 . 50 / 30
	11	10.16.221.52 / 30	Brasil-EUR (tentativo)	-	10 . 15 . 224 . 51 / 30
				Brasil	10 . 15 . 224 . 52 / 30
				EUR (Madrid)	10 . 15 . 224 . 53 / 30
	15	10.15.224.56 / 30	Brasil-NAM	-	10 . 15 . 224 . 54 / 30
				Brasil	10 . 15 . 224 . 55 / 30
				NAM (Astoria)	10 . 15 . 224 . 56 / 30
	16	10.15.224.60 / 30	Brasil-Argentina	-	10 . 15 . 224 . 57 / 30
				Brasil	10 . 15 . 224 . 58 / 30
				Argentina	10 . 15 . 224 . 59 / 30
	17	10.15.224.64 / 30	Brasil-Bolivia	-	10 . 15 . 224 . 60 / 30
				Brasil	10 . 15 . 224 . 61 / 30
				Bolivia	10 . 15 . 224 . 62 / 30
	18	10.15.224.68 / 30	Brasil-Paraguay	-	10 . 15 . 224 . 63 / 30
				Brasil	10 . 15 . 224 . 64 / 30
				Paraguay	10 . 15 . 224 . 65 / 30
	-	-	-	-	10 . 15 . 224 . 66 / 30
	-	-	-	-	10 . 15 . 224 . 67 / 30
	-	-	-	-	10 . 15 . 224 . 68 / 30
-	-	-	-	10 . 15 . 224 . 69 / 30	
-	-	-	-	10 . 15 . 224 . 70 / 30	
-	-	-	-	10 . 15 . 224 . 71 / 30	



IP Addressing Plan

➤ Inter/Intra-Regional Links

Enlaces Inter/Intra Regionales correspondientes a la Región SAM

Red	Enlace			Direcciones a utilizar
	Nro.	Subred	Entrenos	
10.15.224.0 / 19	19	10.15.224.72 / 30	Brasil-Unguay	-
				Brazil
				Ungway
	20	10.15.224.76 / 30	Chile-PAC	-
				Chile
				PAC(Urtraburg)
	21	10.15.224.80 / 30	Chile-Peru	-
				Chile
				Peru
	22	10.15.224.84 / 30	Colombia-NAM	-
				Colombia
				NAM (Atlanta)
23	10.15.224.88 / 30	Colombia-Ecuador	-	
			Colombia	
			Ecuador	
24	10.15.224.92 / 30	Colombia-Peru	-	
			Colombia	
			Peru	
25	10.15.224.96 / 30	Colombia-Venezuela	-	
			Colombia	
			Venezuela	
26	10.15.224.100 / 30	Ecuador-Peru	-	
			Ecuador	
			Peru	
27	10.15.224.104 / 30	Ecuador/Venezuela	-	
			Ecuador	
			Venezuela	




IP Addressing Plan

➤ Inter/Intra-Regional Links

Enlaces Inter/Intra Regionales correspondientes a la Región SAM

Red	Enlace			Direcciones a utilizar
	Nro.	Subred	Entrenos	
10.15.224.0 / 19	29	10.15.224.109 / 30	Guyana Francesa-Surinam	-
				Guyana Francesa
				Surinam
	30	10.15.224.112 / 30	Guyana-C.CAR	-
				Guyana
				C.CAR (Piarco)
	31	10.15.224.116 / 30	Guyana-Surinam	-
				Guyana
				Surinam
	32	10.15.224.120 / 30	Guyana/Venezuela	-
				Guyana
				Venezuela
33	10.15.224.124 / 30	Peru-NAM	-	
			Peru	
			NAM (Atlanta)	
34	10.15.224.128 / 30	Peru-Bolivia	-	
			Peru	
			Bolivia	
35	10.15.224.132 / 30	Peru-Colombia	-	
			Peru	
			Colombia	
36	10.15.224.136 / 30	Peru/Venezuela	-	
			Peru	
			Venezuela	
37	10.15.224.140 / 30	Surinam/Venezuela	-	
			Surinam	
			Venezuela	




IP Addressing Plan

➤ Inter/Intra-Regional Links


Enlaces Inter/Intra Regionales correspondientes a la Región SAM

Red	Enlace			Dimensiones a utilizar	
	Nro.	Subred	Extremos	10 - 15	204 - 254 / 30
10.15.224.0 / 19	37	10.15.221.144 / 30	Venezuela-CM	-	-
			Venezuela	10 - 15 - 224 - 144 / 30	
			CAM (San Juan)	10 - 15 - 224 - 145 / 30	
	38	10.15.224.148 / 30	Venezuela-EUR	-	-
			Venezuela	10 - 15 - 224 - 147 / 30	
			EUR (Madrid)	10 - 15 - 224 - 149 / 30	
	39	10.15.224.152 / 30	Venezuela-Trinidad y Tobago	-	-
			Venezuela	10 - 15 - 224 - 151 / 30	
			Trinidad y Tobago	10 - 15 - 224 - 152 / 30	
	40	10.15.224.156 / 30	VACANTE	-	-
			-	10 - 15 - 224 - 155 / 30	
			-	10 - 15 - 224 - 156 / 30	
41	10.15.224.160 / 30	VACANTE	-	-	
		-	10 - 15 - 224 - 157 / 30		
		-	10 - 15 - 224 - 158 / 30		
42	10.15.224.164 / 30	VACANTE	-	-	
		-	10 - 15 - 224 - 159 / 30		
		-	10 - 15 - 224 - 160 / 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		




Data Acquisition - GNSS

- In 2004, the REDDIG served as connectivity platform for the data acquisition system based on the IP protocol, using routers
- GPS data was collected at critical locations for preliminary modelling of a pre-operational SBAS system for the CAR/SAM Regions and for plotting the disturbing effects of the ionosphere



GNSS Systems


	<i>Nominal constellation</i>	<i>Full operational capability</i>	<i>Number of operational satellites</i>	<i>Coverage</i>	<i>Civilian spectrum</i>
GPS	24	1995	30 (January 2010)	Global	Current 2009: L1 C/A, L2C Future: L1 C/A, L1C, L2C, L5
WAAS	3	IOC/2003 FOC/2008	2	Regional (North America)	Current: L1C/A, L5 Future: L1C/A, L5
GLONASS	21	1995 (GLONASS) 2010 (GLONASS-M)	24 (December 2010)	Global	Current 2007: L1PT, L2PT Future: L1PT, L2PT, L3PT, [*] L1CR, [*] L2CR, [*] L5R [†]
SDCM	2	2014 (expected)	2 geostationary satellites	Wide area (Russian Federation)	SBAS L1 C/A
GALILEO	30 medium Earth orbit satellites	2014	2 medium Earth orbit satellites	Global	E5 OS/SoL E6 CS/PRS E1 OS/SoL/PRS
EGNOS	3 geostationary satellites	2009 for open service 2010 for safety-of-life service	3 geostationary satellites	Regional	Current: L1C/A



GNSS Systems


	<i>Nominal constellation</i>	<i>Full operational capability</i>	<i>Number of operational satellites</i>	<i>Coverage</i>	<i>Civilian spectrum</i>
COMPASS/BeiDou	5 geostationary satellites and 30 non-geostationary satellites	2020	6 (January 2010)	Global	1,559.052-1,591.788 MHz 1,166.22-1,217.37 MHz 1,250.618-1,286.423MHz
GAGAN/IRNSS	3/7	2013/2014		Regional	GAGAN: L5, L1 IRNSS: S, L5 AND L1
MSAS	2 geostationary satellites		2 geostationary satellites (MTSATs)	Asia and the Pacific	L1
QZSS	1 (first phase) 3 (second phase) [*]		1 (FY 2010)	Regional (Asia and Oceania)	L1 C/A, L1C, L2C, L5, L1-SAIF (L1 - submeter-class augmentation with integrity function), LEX (L-Band Experimental Signal)

^{*}Signal structure is under refinement.
[†]Pending final decision.
[‡]The QZSS plan will basically proceed to the second phase of public-private cooperation after the evaluation of the results of technological verifications and demonstrations of the first phase.



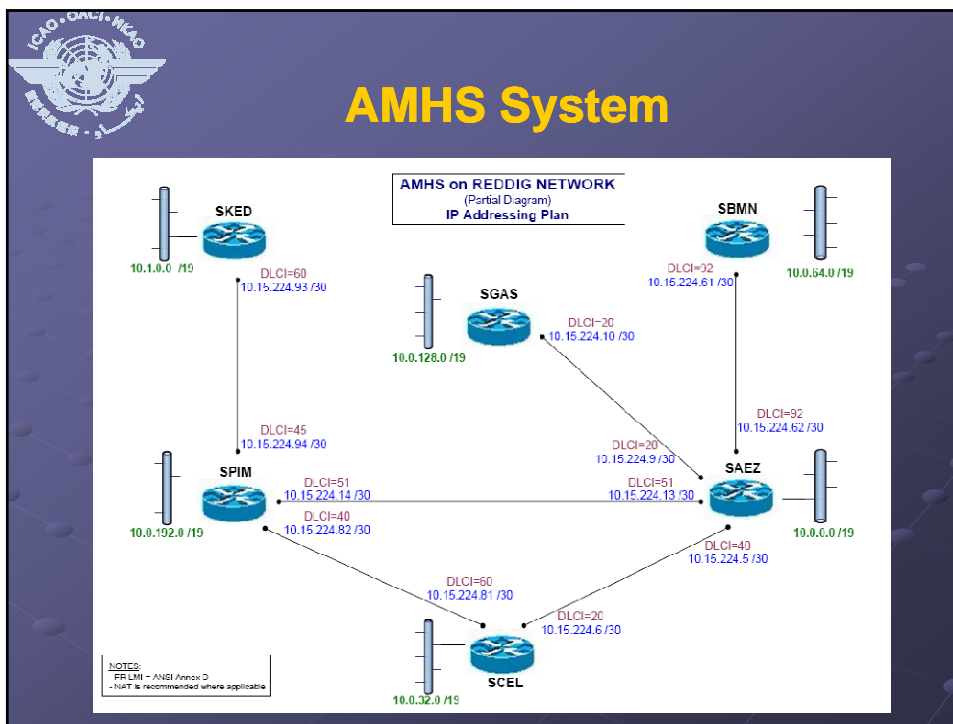
AMHS System

- The AMHS (ATS Message Handling System) is a standard that provides ground-ground aeronautical communication services
- It uses the Internet protocol suite standards
- It uses a gateway to co-exist with the AFTN system




AMHS System

- Main elements:
 - UA : User Agent
 - MTA : Message Transfer Agent
 - MS : Message Store
 - DS : Directory Server



AMHS System SAM Implementation Plan


ITEM	ACTIVIDAD	RESPONSABLE	RESULTADO ESPERADO	ESTADO	FECHA FINALIZACION
1	Revisión del Plan Regional AIN en cuanto a la implementación del sistema AMHS	Secretaría	Plan Regional AIN de aplicación territorial del AIN (Tabla CNS IDB) actualizado	Finalizado	Abril 2008
2	Revisión y migración de direcciones IP de los equipos involucrados	Secretaría	Asignación de direcciones IP	Finalizado	Abril 2008
3	Revisión del plan de direccionamiento CAS		Plan de direccionamiento CAS actualizado	Finalizado	Julio 2008
4	Preparar protocolo de pruebas de interconexión para determinar el modo de enlace que mejor se adapte a la interconexión de sistemas AMHS entre SCA y a través de la REDDIG	Experto CNS Privado (LAASO)	Protocolo de Pruebas de interconexión. Se cubren los puntos de conexión para la interconexión de sistemas AMHS	Finalizado	Diciembre 2008
5	Preparar Guía de Orientación para la implementación Operativa de Sistemas AMHS en la Región SAM	Experto CNS Privado (LAASO)	Guía de Orientación para la implementación Operativa de Sistemas AMHS en la Región SAM	Finalizado	Octubre 2009
6	Elaboración de un listado de SOU de subredes para la implementación de sistemas AMHS	Argentina	Modelo de MTA interconexión sistemas AMHS	Finalizado	Octubre 2009
7	MTA de interconexión para la implementación de sistemas AMHS solamente implementado en la Región SAM	Entes involucrados Región SAM	MTA de interconexión AMHS entre Entes de la Región SAM con sus respectivos ASBIS implementados	Valida	1, 4 & 5 finalizados
8	<p>Fase 1</p> <p>Restricción de pruebas de interconexión entre MTA de REDDIG</p> <p>Tipos de pruebas a realizar: Transporte de red. Conectividad & red. Interconexión de sistemas. Pruebas programadas.</p>	Argentina, Brasil Paraguay y Administración REDDIG	<p>Pruebas de interconexión entre los MTA de Argentina, Brasil y Paraguay</p> <p>a) Pruebas de transporte de red y conectividad realizadas con el modo de enlace de actualizado el ASBIS, para el resto de entes de Brasil será similar. Se requiere las pruebas de conectividad de red, transporte de mensajes de correo.</p> <p>b) Pruebas de transporte de red, conectividad, interconexión de mensajes recibidos.</p>	Valida	Agosto 2010



RADAR Data Exchange


➤ In 2006, radar data and flight plan exchange tests were successfully conducted between the Venezuela (Maiquetía) and Brazil (Amazonico) control centres, using the IP protocol on the REDDIG. Objectives:


- EXCHANGE OF FLIGHT PLAN DATA BETWEEN TWO AUTOMATED CENTRES
- SHARING OF RADAR DATA WITH ADJACENT ACCs FOR TRAFFIC HANDOVER WITH VISUALIZATION



RADAR Data Exchange

➤ Maiquetía ACC – Amazonico ACC Integration






RADAR Data Exchange

- ASTERIX is the global standard format for the exchange of data from different types of radar:
 - Primary
 - Secondary
 - Monopulse
 - Mode S
 - Meteorological

Also for transmitting multi-radar, M&C and other related data.



RADAR Data Exchange

Recommendations

- Format : ASTERIX
- Network protocol : IP
- Link protocol : IP / FR




CNS/ATM Integration

- Interconnection of ATC automated systems for automated transmission of data on flight plans and surveillance of flights in transition to an adjacent FIR
- As a result, coordination of air traffic control and flight handover will improve



CNS/ATM Applications

- AMHS
ATS Message Handling System
- AIDC
ATS Interfacility Data Communications
- OLDI
On-Line Data Interchange




CNS/ATM Applications

➤ **AIDC**

Application enabling the exchange of information between two ATS units supporting critical ATC functions

- Flight notification
- Flight coordination
- Handover control
- Transfer of communications
- Transfer of surveillance data
- Transfer of general data



CNS/ATM Applications

➤ **AIDC**

Will largely reduce the need for verbal coordination, thus eliminating language and other problems of a local nature

Accordingly, message formats and procedures are designed to eliminate misinterpretations.



CNS/ATM Applications

➤ AIDC

Checks the consistency of the response to a request, facilitating automation and assistance for:

clearance,
transfer and
control of aircraft

for flight plans between ACCs



CNS/ATM Applications

➤ OLDI

Initially developed in Europa in the 80's.

Used for the migration to AIDC due to its operational use of direct connections between flight data processing systems (FDPS) in the ACCs.

Replaces verbal "estimates".



CNS/ATM Applications

➤ OLDI

Use of OLDI permits the ATC to:

- Receive this type of messages
- Process them automatically according to this protocol
- Produce flight data based on the message received, and report any inconsistencies
- Automatically transmit acknowledgment messages.