

CNS/SG/2 - IP/04
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INTERNATIONAL CIVIL AVIATION ORGANIZATION

AFI PLANNING AND IMPLEMENTATION REGIONAL GROUP (APIRG)
COMMUNICATIONS, NAVIGATION AND SURVEILLANCE SUB-GROUP SECOND
MEETING
(CNS/SG/2)

(Dakar, Senegal 22 – 25 May 2007)

Agenda Item 4: Communications
Agenda Item 5: Navigation
Agenda Item 6: Surveillance

Report on CNS related issues discussed at the
Thirteenth Informal Coordination Meeting on the Improvement of Air
Traffic Services over the South Atlantic SAT/13, Canary Island, Spain, 24-27 April 2006)

(Presented by the Secretariat)

1. Introduction

1.1 The Thirteenth Informal Coordination Meeting on the improvement of air traffic services over the South Atlantic (SAT/13) was held in Las Palmas, Canary Island (Spain), from 24 to 27 April 2006. The meeting was hosted by AENA, Spain and was held at the New Area Control Centre. This paper contains extracts from SAT/13 related to communications, navigation and surveillance issues.

2. Discussions

2.1 Follow up of SAT/12 Conclusions pertaining to the CNS field

2.1.1 Under this agenda item, the meeting reviewed the implementation status of the conclusions and decisions adopted by the Twelfth Meeting on the improvement of air traffic services over the South Atlantic (SAT/12), which was held in Sal Island, Cape Verde Archipelago, 15 – 17 December 2004, and follow-up actions taken thereon by SAT Members and the Secretariat. The implementation status of these conclusions and decisions is shown at **Appendix 2-A** to this part of the report.

2.2 Review of the Report of the SAT/12 CNS Working Group

2.2.1 Under this Agenda item, the meeting reviewed the Report on the SAT/12 Task Force Meeting (Rio de Janeiro, Brazil, from 5 to 9 September 2005) as summarized by the Secretariat. The meeting particularly analyzed the SAT Task Force draft conclusions and decisions covering operational and technical issues, and endorsed most of these conclusions and decisions following further discussions under Agenda items 2, 3, 4, 5 and 6.

2.3 Review of AFS performance

Interconnection between CAFSAT and SADC networks: ATS/DS Link Atlantico/Luanda

2.3.1 The meeting acknowledged the need for a proper ATS/DS link between Atlantico and Luanda ACCs, and came to the realization that a dedicated CAFSAT node may not be cost-effective due to the level of traffic and distance between the two ACCs. It therefore suggested that Angola, Brazil and South Africa consider implementing this requirement through an interconnection between CAFSAT and SADC networks. Meanwhile, a PSTN link should be used. The following conclusion was formulated:

CONCLUSION SAT13/11: IMPLEMENTATION OF ATLANTICO/LUANDA ATS/DS CIRCUIT

THAT ANGOLA, BRAZIL AND SOUTH AFRICA CONSIDER THE IMPLEMENTATION OF ATLANTICO/LUANDA ATS/DS LINK VIA JOHANNESBURG THROUGH CAFSAT/SADC INTERCONNECTION.

Interconnection between CAFSAT and AFISNET networks: ATS/DS Links Las Palmas/ Nouadhibou and Las Palmas/Nouakchott

2.3.2 The meeting was informed of a technical meeting that took place in Las Palmas from 26 to 27 October 2005, with the participation of Cape Verde, Portugal, Spain, ASECNA and industry providers, which identified as a matter of urgency the need for achieving interconnection between AFISNET and CAFSAT networks. It was provided with detailed information on a proposed technical solution combining an RF subsystem using AFISNET space segment capacity on Satellite IS 10-02, and a baseband subsystem using CAFSAT system.

2.3.3 Issues related to equipment selection and system control and monitoring were also analyzed to ensure system compatibility at FR level and modem level, including NMS software adjustments. After discussions, the following conclusion was formulated:

CONCLUSION SAT13/12: IMPLEMENTATION OF LAS PALMAS/NOUADHIBOU AND LAS PALMAS/NOUAKCHOTT ATS/DS LINKS

THAT AENA (SPAIN) AND ASECNA EXPLORE WAYS AND MEANS OF SOLVING AS SOON AS POSSIBLE THE ATS/DS DEFICIENCIES BETWEEN LAS PALMAS AND NOUKCHOTT AND BETWEEN LAS PALMAS AND NOUADHIBOU ATS UNITS, BASED ON THE AGREED PRINCIPLE OF INTERCONNECTING AFISNET-CAFSAT AS THE OPTIMAL TECHNICAL SOLUTION.

2.4 Interoperability between aeronautical VSAT networks and potential use of digital VSAT networks to support ATM applications

VSAT Integration

2.4.1 A comprehensive presentation by the ICAO Secretariat provided the meeting with an overview of the issues associated with the implementation, operation and evolution of the communication networks that are based on very small aperture terminal (VSAT) technology and are used in some ICAO Regions mainly to support the provision of the aeronautical fixed service (AFS). Emphasis was put on the following :

Interconnection problems

2.4.1 Interconnection between two VSAT networks is in general more complex, especially if the networks use different satellites, access schemes and protocols. In general, interconnection of VSAT networks increases complexity/cost and degrades the overall performance (especially for voice communications). As such, ideally where there is proper satellite coverage over a certain area, efforts should be made to implement a single VSAT network. Unfortunately, in practice this principle has not always been followed mainly on non-technical grounds. Hence the need for a solution to the growing problem of interconnection between neighbouring digital networks, especially if one or more are VSAT- based.

Use of Internet Protocol (IP) technology

2.4.2 It was the view of the Secretariat that Internet Protocol (IP) based networks, provide the optimum means of establishing regional/inter-regional aviation intranets that would enable access by all users to vast resources available on the Internet (e.g. aeronautical meteorology and other data bases).

2.4.3 Another point considered was the need to exploit all the possibilities that modern technology offers. For example, the exchange of OPMET data by table-driven codes that will be phased in through amendments to Annex 3 — *Meteorological Service for International Air Navigation* between 2007 and 2016) cannot be accomplished by AFTN protocols. As such, the use of the Internet Protocol Suite (IPS) and associated Internet-based software (e.g. e-mail) should be further encouraged.

Standardization issues

2.4.4 The choice of the medium (e.g. terrestrial or satellite) for the provision of the AFS has never been the subject of Standardization by ICAO. The interconnection between two digital networks is a local matter that involves recovery of the bit streams from one and reformatting them for transmission over the other. In this regard, it would be fair to say that it is not practical for ICAO to develop provisions covering all possible types of physical and protocol interfaces. However, certain performance-based provisions could be developed to govern the end-to-end requirements and to narrow the choices for technologies employed.

2.4.5 In addition to ICAO's work on provisions relating to the use of the IP, Internet and related protocols for aeronautical applications (Note¹), it should be noted that provisions have already been developed to use an IP network as a subnetwork of the aeronautical telecommunication network (ATN).

2.4.6 In summary, although not yet standardized by ICAO, IP is the most widely method of networking that provides global connectivity in the most economical manner. Moreover, all indications are that IP will (in the form of IP Version 6 with its enhanced security features) continue to be the dominant technology of the foreseeable future. Therefore, where available and cost effective, the alternative of leasing an IP-based virtual private network (VPN) for aeronautical applications should be duly considered. Again, a universally agreed set of end-to-end performance requirements would greatly facilitate the formulation and administration of contracts for obtaining such services. The following conclusions were formulated:

CONCLUSION SAT13/13: AERONAUTICAL COMMUNICATIONS NETWORK DEVELOPMENT STRATEGIES

THAT SAT STATES AND ORGANIZATIONS CONCERNED:

¹ Note : ICAO Doc 9855 – *Use of Public Internet for Aviation Applications*.

- a) **TAKE THE PROPER ACTIONS TO ACHIEVE AND APPLY COMPREHENSIVE STRATEGIES FOR THE INTERCONNECTION OF VSAT NETWORKS TO MEET ATS REQUIREMENTS IN THE SOUTH ATLANTIC AREA;**
- b) **WORK TOWARDS SEAMLESS REGIONAL/INTER-REGIONAL DIGITAL COMMUNICATION NETWORKS BASED ON THE INTERNET PROTOCOL SUITE (IPS);**
- c) **GIVE DUE CONSIDERATION TO MANAGED NETWORK SERVICES (E.G. A VIRTUAL PRIVATE NETWORK (VPN)) SUBJECT TO AVAILABILITY AND COST EFFECTIVENESS.**

CONCLUSION SAT13/14: STANDARDIZATION OF THE INTERNET PROTOCOL SUITE AND NEED FOR END-TO-END PERFORMANCE REQUIREMENTS

THAT ICAO BE REQUESTED TO EXPEDITE ITS WORK ON:

- a) **THE STANDARDIZATION OF THE INTERNET PROTOCOL SUITE FOR THE STATES AND ORGANIZATIONS TO IMPLEMENT IT IN CONFORMITY WITH ARTICLE 28 OF THE CHICAGO CONVENTION; AND**
- b) **THE ESTABLISHMENT OF A UNIVERSALLY AGREED SET OF END-TO-END PERFORMANCE REQUIREMENTS TO FACILITATE THE FORMULATION AND ADMINISTRATION OF CONTRACTS FOR OBTAINING MANAGED NETWORK SERVICES.**

CONCLUSION SAT13/15: COMMUNICATIONS SYSTEMS UPGRADING AND MAINTENANCE

THAT SAT STATES AND ORGANIZATIONS CONCERNED TAKE THE NECESSARY STEPS TO UPGRADE AS REQUIRED AND SECURE SPARE PARTS OF THE OPERATIONAL EQUIPMENT IN ORDER TO MINIMIZE ANY POTENTIAL CRITICAL IMPACT ON THE CURRENT COMMUNICATIONS SYSTEM.

Numbering Plan for the AFI Region

2.4.7 The meeting recalled that, in accordance with the provisions in “ICAO DOC 9804 - Manual on ATS Ground-Ground Voice Switching and Signalling”, Chapter 2 Section 2.3 : “*The numbering plan is an essential element in a switched communication system. It identifies all users and provides necessary information to the switching equipment for the routing of the traffic. Numbering plans in general have to balance the desire to keep the number of digits dialled for a call to the minimum while including the possibility of expansion beyond the planned capacity without changing the basic structure of the plan*”. The following recommended characteristics for the numbering plan were noted:

- a) Numbers should consist of six digits, whereby the first two digits identify the area, the third and fourth digits, the ATS unit, and the fifth and sixth digits, the CWP or correspondent within the ATS unit.
- b) The area identifier may be used to identify either a single country or a group of countries.

2.4.9 In order to save space in the numbering plan it is possible for ANSP’s to allocate the last four digits (i.e. CC and NN) as the address of a CWP. If this is applied then a single ATS unit can be identified with different pairs of CC digits. Ideally the addresses allocated to a particular ATS unit should be in single range in the numbering plan and should not be divided into separate ranges or be split around numbering plan ranges allocated to other ATS units. If this methodology is applied however it implies that configuration of the routing tables within a VCS will be more complex.

2.4.10 The following conclusion was formulated:

CONCLUSION SAT13/16: ATS VOICE NUMBERING PLANS FOR AFI AND SAM REGIONS

THAT SAT STATES, ORGANIZATIONS CONCERNED AND ICAO REGIONAL OFFICES, DAKAR AND LIMA TAKE THE NECESSARY STEPS TO INCLUDE IN GREPECAS AND APIRG WORK PROGRAMMES STUDIES ON THE IMPLEMENTATION OF ATS VOICE NUMBERING PLANS FOR AFI AND SAM REGIONS, AS DEFINED BY THE RECOMMENDATION CONTAINED WITHIN THE ICAO MANUAL ON ATS GROUND-GROUND VOICE SWITCHING AND SIGNALLING (DOC 9804, CHAPTER 2 SECTION 2.3).

ATS-N5 protocol proposal in EUR-SAM corridor

2.4.11 The meeting acknowledged the advantages of using an ATS Ground Voice Switching Network as follows :

- 1) Reduction of the number of circuits (Ground-Ground links are shared by a number of users);
- 2) More than one link to access to a user;
- 3) Direct route and alternate routes are configured among VCSs for call routing;
- 4) Normal and Priority calls;
- 5) Automatic line checking.

2.4.12 Following a comparative analysis of the ATS-R2 or ATS-N5 signalling systems and based on the experience gained in EUR Region, the meeting recognized the need for a common call signalling protocol in the SAT area. Noting that the “compelled” characteristic of the ATS-R2 register signals makes ATS-R2 unfeasible for those cases where the signal propagation delay is greater than 35 ms, whilst the “non-compelled” characteristic of the ATS-N5 register signals makes ATS-N5 less sensitive to signal propagation delay, the meeting therefore agreed that the ATS-N5 signalling system was specially useful in those ground lines where propagation delays are high, or where satellite links are (to be) used. A detailed description of ATS-N5 signalling system was provided to the meeting, including related register signals (tone pairs representing individual digits and status signals).

2.4.13 Moreover, the meeting discussed the possibility of using audio CODECs algorithms in order to implement the AGVN ATS-N5 signalling protocol in VSAT links, to guarantee the voice transmission characteristics and to minimize the latency time effect on the transmission. Based on the MOS (Mean Opinion Score) criteria, the suggested CODECs should have a MOS score better than 4 (See Figure 6 below).

2.4.14 A first approach would be to compare all the CODECs which are considered as “good” regarding the audio point of view.

2.4.15 Table below provides different proposed CODECs :

- *Voice is considered to be in the 300-3400Hz bandwidth.*
- *Tone is equivalent to the usual frequencies defined for telephone application: (330 Hz, 440Hz, 1000Hz....)*
- *DTMF: is equivalent to the Q.23 Keypad codes used with usual telephone.*
- *MOS or E model: user satisfaction for voice quality reference*
- *Signalling: is equivalent to Modem frequencies or ATS-R2/ATS-N5 frequencies*
- *MIPS gives indication regarding the necessary computational power needed for the CODEC.*

CODEC TYPE	Algorithm	Kb/s	Delay (ms)	MIPS	MOS	Voice	Tones	DTMF	Signalling
G711 A-law, μ-law	PCM	64	0,75-1	0-0,1	4,5	excellent	excellent	excellent	excellent
G726 32K	ADPCM	32	1-2,5	6-7	4	fine	good	good	medium
G728	LD CELP	16	2-5	33-40	4	fine	good	good	medium
G729A	CS-ACELP	8	15	15	4	fine	good	good	bad

2.4.16 Classification from the best to the worst:

- *Excellent* > *No problem to use it for this type of audio signals*
- *Fine* > *May be used to transmit this type of signal*
- *Good* > *May be used but may introduce some modification of the signal*
- *Medium* > *Introduce serious modification or distortion on the signal*
- *Bad* > *Unable to transmit this type of signal*

2.4.17 AENA kindly provided the meeting with a satisfactory live demonstration thereof.

2.4.18 The following conclusion was formulated :

CONCLUSION SAT13/17: IMPLEMENTATION OF ATS No.5 PROTOCOL IN THE SAT AREA**THAT:**

- a) SAT STATES AND ORGANIZATIONS BE ENCOURAGED TO CARRY OUT TECHNICAL RESEARCH AND IN-DEPTH INVESTIGATIONS ON THEIR SYSTEMS IN VIEW OF A POTENTIAL IMPLEMENTATION OF THE ATS No.5 PROTOCOL IN THE SAT AREA, IN ACCORDANCE WITH ICAO GUIDANCE MATERIAL CONTAINED IN ANNEX 10 AND DOC 9804;
- b) CAPE VERDE, PORTUGAL, SPAIN AND ASECNA IMPLEMENT TRIALS IN ORDER TO ESTABLISH THE PREREQUISITES RELATED TO THE IMPLEMENTATION OF ATS-N5 SIGNALLING USING VSAT LINKS AND APPROPRIATE CODECS (AS REQUIRED); AND
- c) SAT CNS WORKING GROUP WORK PROGRAMME BE AMENDED TO INCLUDE THE ANALYSIS OF ALL ASPECTS RELATED TO THE IMPLEMENTATION OF ATS No.5 PROTOCOL.

Interconnection between AFISNET, SADC/2 and NAFISAT networks

2.4.19 ATNS, South Africa provided the meeting with updated information on SADC/2 and NAFISAT projects. The meeting was informed that ATNS has issued a "Request for Tender" during December 2005 to a selected shortlist of tenderers, after completion of a "Registration of Interest" phase. The tender responses were under evaluation and it was expected that a contract would be entered into towards the end of April 2006. The "Request for Tender" documentation included a suggested remote VSAT terminal configuration for integration and interoperable functionality with the AFISNET VSAT network.

2.4.20 The meeting supported a suggested solution to solve the interconnection requirement, based on ATNS providing additional SCPC (Single Channel per Carrier) point-to-point satellite communication ground terminal facilities, similar to that being used within the AFISNET network, at the identified NAFISAT and SADC sites. This entails that no ATNS VSAT terminals shall be provided at AFISNET sites as part of the NAFISAT and SADC/2 network deployment. Algeria, GCAA (Ghana) and ASECNA are only required to equip the reciprocal AFISNET sites with additional individual SCPC modems for reception and transmission of the required SCPC carriers from and between the identified AFISNET (Accra, Abidjan (Dakar), Algiers, Brazzaville, Niamey and Ndjamena) and NAFISAT/SADC sites (Addis Ababa, Khartoum, Luanda, Nairobi and Tripoli).

Amendment proposals to AFI and SAM AFTN Routing Directories

2.4.21 The meeting recalled Annex 10, Volume II, Para. 4.4.1.3.1 requesting that "all communications be routed by the most expeditious route available to effect delivery to the addressee", and it recognized that Johannesburg CAFSAT Station offered possibilities of improving the transit of AFTN messages between AFI and SAM Regions. The meeting therefore endorsed an amendment proposal to the AFI and SAM AFTN Routing Directories, as summarized in Table below:

Destination	Origin													
	1		2		3									
	MPPC		SAEZ		SBBR		SCSC		SEGU		SGAS		SKBO	
<u>E</u> <u>(Except FC, FE, FG, FH, FI, EJ, FK, FM, FO, FP, FT)</u>	KA	sk	SB	sp	FA	go	SP	sa	SP	sk	SB	sa	SV	sp
<u>FC, FE, FG, FH, FI, FJ, FK, FM, FO, FP, FT</u>	KA	sk	SB	sp	GO	le	SP	sa	SP	sk	SB	sa	SV	sp

2.4.22 The following conclusion was formulated accordingly:

CONCLUSION SAT13/18: AMENDMENT PROPOSALS TO AFI AND SAM AFTN ROUTING DIRECTORIES

THAT AFI AND SAM AFTN ROUTING DIRECTORIES BE AMENDED TO INCORPORATE EZEIZA/JOHANNESBURG AND JOHANNESBURG/RECIFE CIRCUITS.

2.5 Harmonization of ADS/CPDLC programmes

Review of the Report of the FANS/1-A Interoperability Team

2.5.1 The meeting reviewed the Report of the First Meeting of SAT FANS/1-A Interoperability Team (SAT/TF/1) and noted that this meeting discussed among other issues all the aspects of the SAT FANS/1-A Operational Manual (FOM), the FANS 1/A implementation activities in the South Atlantic, the system performance monitoring and maintenance and the future work programme of the Team. SAT/TF/1 Report has been made available on the ICAO public website: <http://www.icao.int> .

2.5.2 After analyzing SAT/TF/1 Report, the meeting endorsed and formulated the following conclusions:

CONCLUSION SAT/13/19: IMPLEMENTATION OF ADS/CPDLC PLANS BY SAT STATES

THAT SAT STATES AND ORGANIZATIONS BE ENCOURAGED TO COMPLY WITH THEIR ADS/CPDLC IMPLEMENTATION PLANS IN A TIMELY MANNER.

CONCLUSION SAT/13/20: NEED FOR A CONSOLIDATED DATABASE FOR FANS1/A EQUIPPED AIRCRAFT

THAT A CONSOLIDATED DATABASE BE CREATED TO IDENTIFY FANS1/A EQUIPPED AIRCRAFT OPERATING IN THE SOUTH ATLANTIC.

CONCLUSION SAT/13/21: PARTICIPATION OF REGULATORS AND MAIN AIRLINES IN SAT/FIT MEETINGS

THAT:

- a) IN CASES WHERE THE REGULATORS ARE DIFFERENT THAN THE AIR NAVIGATION SERVICE PROVIDERS, SAT STATES SHOULD ENSURE PARTICIPATION OF REGULATORS IN SAT/FIT MEETINGS IN ORDER TO HAVE FULL COMMITMENT TO THE IMPLEMENTATION PLAN; AND**
- b) MAIN AIRLINES REPRESENTATIVES SHOULD ALSO PARTICIPATE IN SAT/FIT MEETINGS.**

2.6. Harmonization of CNS/ATM systems evolution tables

2.6.1 The meeting did not review the AFI and SAM CNS/ATM systems evolution tables. The Secretariat was requested to prepare updated tables for the next meeting to ensure harmonization thereof.

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