

**INTERNATIONAL CIVIL AVIATION ORGANIZATION**

**Ninth Informal Meeting for the Improvement of Air Traffic Services  
over the South Atlantic (SAT/9 Meeting)**

**(Lima, Peru 6 to 10 November 2000)**

Agenda item 5: **Communications**

**AM(R)S and AFS communications in the AFI/SAM regional interface**

(Presented by the Secretariat)

**Summary**

This working paper presents information on the planning and implementation of the fixed and mobile AFI/SAM inter-regional communications. In so doing the meeting will be presented with updated information on the developments in the AFS related with the AFI and CAR/SAM plans as well as on the Mobile Service and perspectives to implement data link communications in support of the CPDLC and ADS in the EUR/SAM corridor as part of the evolutionary introduction of ATM automation .

**1. Analysis**

1.1 The EUR/SAM corridor is being used to conduct an evolutionary implementation of ATM improvements that, in close relation with the CNS/ATM plans developed by the AFI and CAR/SAM regions, will require the support of related communication elements.

2 The ATM service provision would be made through the communication systems recommended in the AFI and CAR/SAM air navigation plans, and would require the implementation of digital communications in support of the development of automation functions to implement ATN applications such as AIDC and AMHS for the ground/ground applications, and CPDLC and ADS for the ground/air applications.

1.3 A reliable and efficient communication service using the conventional systems will require:

- a) replacement of the current voice circuit Recife ACC-Dakar ACC by a highly reliable and efficient direct speech circuit linking the mentioned ATS units;

- b) replacement of the current 50 bauds AFTN channel linking the AFTN communication centres of Brazil and Dakar with a high speed reliable and efficient AFTN circuit; and
- c) implementation of the adequate HF coverage for 24 hours operation at the aeronautical stations of Dakar and Recife.

1.4 From the point of view of the communication elements required to support ground/ground and air/ground ATN applications, it should be noted that Brazil and Senegal, taking into account the corresponding regional plans for the CNS/ATM systems, should develop the corresponding planning. In this regard, it should be noted that in the CAR/SAM FASID the following elements related with/or for Recife ACC (Atlantico ACC) are recommended:

- 1) as elements of the SAM ATN backbone, a BIS router for Brazil is recommended. It is expected that this router be connected with the AFI (Dakar), NAM (Atlanta) and EUR (Madrid) BIS routers. The router implementation is expected for 2004;
- 2) for ground/ground applications, the AMHS and AIDC in Brazil are recommended. In this regard, an AMHS was recommended to be implemented by 2004; and
- 3) air/ground ATN applications, such as CPDLC and ADS to be implemented in AMSS, and HF/DL ATN compatible ATN sub-networks were recommended for 2008.

Plans for Senegal on the above are not available.

## 2 Discussion

### 2.1 Aeronautical Fixed Service (AFS)

2.1.1 Two major developments in communication are taking place in the AFI and SAM regions, connected with the improvements of the ATM in the EUR/SAM corridor. These developments are the implementation of the CAFSAT and REDDIG digital networks, which are designed to support the current or conventional communication requirements, as well as those related with the future CNS/ATM systems.

2.1.2 The CAFSAT is a VSAT network using Frame Relay as network protocol and MCPC technique to access to the satellite. This network was designed to meet the voice and data communication requirements for the FIRs of Canarias, Casablanca, Sal, Dakar, Santa Maria, Lisboa and Recife. So far, three nodes are implemented (Canarias, Dakar and Sal) and it is expected that, at the end of this year, the nodes of Casablanca and Recife would be in operation. The situation concerning Lisboa and Santa Maria nodes is not well known and it is expected that during the meeting additional information on the CAFSAT implementation will be provided.

2.1.2.1 In relation with the communication requirements in the regional interface AFI/SAM, the CAFSAT network will provide data and voice communication channels inside of the 64 Kbps IBS circuit of the Recife node linked with Dakar and Canarias nodes, as follows:

- a) A new voice channel for ATS coordination purposes Recife ACC (Atlantico ACC in the future)-Dakar ACC using the ITU standard G.728 for 8 Kbps data rate;
- b) The AFTN channel linking the AFTN Communication centres of Brazil and Dakar; and
- c) The X.25/AFTN channel linking the AFTN communication centres of Brazil and Madrid passing through the CAFSAT Canarias Node as a gateway to the Spanish REDAN network.

2.1.2.2 In relation with the above, it should be noted that 1) resolves the problem of the current ATS speech circuit, 3) eliminates the payment by Brazil and Spain of the current X.25 dedicated circuit. However, the attention of the meeting should be focused to the implementation of the AFTN channel Brazil-Dakar. From the point of view of the resources offered by the mentioned IBS channel, any low data modulation rate implementation for the Brazil-Dakar AFTN channel should be eliminated. In this regard, the meeting is invited to note that the recommendation, according to the CAR/SAM FASID for this circuit, is to implement X.25/AFTN circuits at 2400 bps using the code IA-5. In relation with this matter, the meeting is invited to formulate the following Conclusion:

**Conclusion SAT/9/XX- Implementation of an X.25/AFTN circuit Brazil-Dakar using the CAFSAT network**

Once the CAFSAT Recife node is implemented, Brazil and Senegal should coordinate to implement the AFTN channel Brazil-Dakar, meeting the following technical specifications:

- Mode: Full duplex, synchronous mode.
- Line Code: International alphabet No 5 (IA-5).
- Circuit Modulation rate (minimum): 2.4 Kbps
- Circuit protocol: X.25

2.1.2.3 The above conclusion can be implemented if the Dakar AFTN switching system has an X.25 interface. Regarding Brazil, as part of the new AFTN system, a Concentrator was implemented in Recife, which could have the possibility to provide an X.25 interface. Otherwise, the AFTN Switching system in Brasilia has an X.25 interface, which can be connected with Dakar using the I/O data unit in the CAFSAT multiplexer corresponding to the Dakar AFTN channel.

2.1.2.4 For reference of the meeting, the X.25 Interface Control Document (ICD) applicable in the CAR/SAM Regions will be available during the meeting. It should be noted that, under the conditions of this ICD, the Brazil-Madrid AFTN circuit was implemented.

2.1.2.5 If the implementation of the Brazil-Dakar AFTN circuit could be not conducted as indicated above, the meeting should agree to the technical condition to implement an asynchronous medium speed data circuit.

2.1.3 Concerning the SAM Digital network (REDDIG), a presentation will be provided to the meeting. The REDDIG, which is in its implementation process, will use the satellite for its physical connections; however, the network itself is represented by its nodes equipment, which can be also connected to the ISDN/FR public services as a main or back/up system. The network will use Frame Relay as the network protocol and the satellite access would be either TDMA or MCPC. The REDDIG will have a node in Recife.

2.1.4 In the light of the Rec. 9/1 formulated by the CAR/SAM/3 RAN meeting, where the States are concerned with the interconnection of digital networks, it should be noted that, from the point of view of the CAFSAT and REDDIG interconnection, the following channels should be considered to cross the boundaries of both networks:

- a) Brazil-Dakar and Brazil-Madrid AFTN channels; and
- b) Brazil-AFI and Brazil/EUR ATN channels to link ATN BIS routers.

2.1.4.1 As a possibility, it should be noted that the current AFTN asynchronous channel Caracas-Madrid could also be routed via REDDIG/CAFSAT in the same way as the Brazil-Madrid X.25/AFTN channel .

2.1.4.2 Based on the above and considering the need to establish a timely coordination to implement the interconnection of the above data channels through the CAFSAT/REDDIG networks, the meeting is invited to formulate the following Conclusion:

**Conclusion SAT/9/XX- Interconnection of data channels through the REDDIG and CAFSAT digital networks**

That Brazil, Spain and Senegal establish the required coordination in order to agree on plans to interconnect through the CAFSAT and REDDIG networks, the corresponding data channels for AFTN and ATN purposes to link the SAM, EUR and AFI regions.

2.1.4.3 In relation with the data channels to link ATN routers, it should be noted that X.25 networks can be used in correspondence with the current ICAO SARPs; however, FR networks can be used to transmit X.25 packets and, in the future, when the sub-network dependence convergence function (SNDCF) for FR is developed, direct FR data links to connect ATN routers could be also used.

2.1.5 It should be noted that, with the implementation of the voice and data communications implemented in the CAFSAT network and interconnected with the REDDIG, the EUR/SAM corridor will have an efficient and reliable AFS communications for a long time, which will allow the implementation of the RVSM and RNP 10. However, in the medium term, ATN ground applications will appear as a need for additional ATM improvements. Concerning this matter, implementation of AMHS and AIDC should be discussed. In this regard, it should be noted that, from the point of view of CAR/SAM FASID, Brazil should implement these ATN ground applications by 2004. Of course several technical matters for a detailed regional planning are still pending of definitions, and it is expected that GREPECAS in the CAR/SAM regions, will

produce the corresponding guidance material. In the EUR region, Spain has already implemented AMHS and the corresponding AFTN/AMHS gateway. It would be of interest, for planning purposes, to know the plans of Senegal in respect on AMHS and AIDC. In this respect, the meeting may wish to discuss this matter and, based on the results of the discussion, the need for a formulation of a adequate Conclusion could arise.

**2.2 En- route Aeronautical Mobile Service (AM(R)S)**

2.2.1 From the point of view of the en-route air/ground communications, the conventional system uses VHF and HF voice communications. ICAO recommendations are indicated in the CAR/SAM FASID and the AFI Regional Air Navigation Plan.

2.2.2 VHF communications for air routes in the oceanic area of the EUR/SAM corridor currently covers from the shoreline up to 250 NM at FL250, such is the case of the VHF station at Fernando de Noronha island currently serving the Recife ACC and in the future the Atlantico ACC. In order to provide reliable and efficient VHF communications within the coverage of the VHF stations, the ACCs in the EUR/SAM corridor should implement for the ACCs the corresponding VHF channels, as recommended in the ICAO Regional Plans, using frequencies free of any interference and according the ICAO SARPs contained in Annex 10, Vol III, Part II, Chapter 2.

2.2.3 In relation with the HF voice communications, the same are performed by the aeronautical stations recommended in the CAR/SAM FASID and the AFI Air Navigation Plan. These means of communication are the most used in oceanic areas of the EUR/SAM corridor. SAT voice communications is also available, but the current costs of implementation and operation limited the feasibility of the use by the airlines and ATS providers of this technology.

2.2.3.1 At the aeronautical stations, the ITU HF families/HF network designators indicated in Appendix S27 of the Radio Regulations should be implemented. In this regard, for each aeronautical station is recommended the corresponding HF frequency families to cover the EUR/SAM corridor, as follows;

<b>Aeronautical Station</b>	<b>HF frequency Families.</b>	<b>Number of Frequencies</b>
Recife (Atlantico)	SAT-1	5 (4)
	SAT-2	5 (2)
	SAM-2	6(1)
Dakar	SAT-1	5
	SAT-2	5
	AFI-1	6
Sal	AFI-1	6
	AFI-2	5
	SAT-1	5
	SAT-2	5
Canarias	SAT-2	5
Casablanca	AFI-1	6

2.2.3.2 The above table shows in the last column the number of frequencies for each family, in parentheses appears the implemented frequencies (case of Brazil is shown). The meeting should note the importance to implement a suitable set of frequencies to cover 24 hours the communication services considering the season and daily changes of the ionosphere. In this regard, it is expected that the meeting, in correspondence to the plans to implement the RNP 10 and RVSM, be provided with information on the communications efficiency and reliability of the HF voice communications services provided by the HF systems of the above indicated aeronautical stations and if the same are implemented following the recommendations of ICAO (CAR/SAM FASID and AFI ANP). Based on this information, the meeting may wish to consider the formulation of a suitable conclusion.

2.2.4 The meeting may wish to discuss the perspectives of implementation of air/ground applications such as CPDLC and ADS. The implementation of these applications require the implementation of air/ground data links, which could be implemented for oceanic areas by satellite (SATCOM) or by HF data link. In this regard, it should be noted that currently the mentioned applications and the corresponding data links can be implemented by using, at the airborne side, the FANS 1/A system and the ATM providers could lease the service to companies like ARINC or SITA. Some States have developed their own approach and Spain, in this respect, is in an advanced stage concerning the implementation of ADS and the dissemination of ADS messages through the CAFSAT network without increasing the space segment cost (WP/18 refers).

2.2.4.1 As it was indicated above (para. 1.4 refers) the CAR/SAM FASID recommends for the Atlantico ACC the implementation of HFDL and AMSS by 2008. This implementation is based in compatible ATN sub-networks in harmony with the ground implementation. From the two sub-networks, HFDL has for the moment a greater feasibility to be implemented. The important matter concerning this subject is to determine if the plans recommended in the CAR/SAM FASID are compatible with the plans for other ACCs of the EUR/SAM corridor to implement CPDLC and ADS applications so as to establish an inter-regional coordination and an adequate implementation time frame.

### 3. **Action suggested**

3.1 In the light of the plans to implement the RNP 10, RVSM and other ATM functions in the future, the meeting is invited to consider the information presented in this working paper in order to:

- a) note the status of implementation of the CAFSAT and REDDIG networks, which will provide the corresponding improvements for the AFS in order to meet current and future communication requirements for the EUR/SAM corridor;
- b) consider the Conclusion proposed in paragraph 2.1.2.2, aimed at implementing the Brazil-Dakar AFTN circuit following the CAR/SAM FASID recommendations;
- c) consider the Conclusion proposed in paragraph 2.1.4.2, aimed at establishing the timely coordination among Brazil, Senegal and Spain to deal with the interconnection of the corresponding data channels crossing the boundaries of the CAFSAT and REDDIG networks;
- d) discuss plans for the ATN backbone in the EUR/SAM corridor and the implementation of AMHS and AIDC;

- e) examine the provision of VHF and HF voice communications in the EUR/SAM corridor in relation with efficiency, reliability and coverage; and
- f) discuss the implementation of air/ground data links and the implementation of CPDLC and ADS applications.

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