REVISED VERSION

INTERNATIONAL CIVIL AVIATION ORGANIZATION

REPORT OF THE

RLA/00/009 PROJECT COORDINATION MEETING

ON GNSS AUGMENTATION TRIALS

(Santiago, Chile, 1 to 3 August 2001)

August 2001

INTERNATIONAL CIVIL AVIATION ORGANIZATION

REPORT OF THE

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ii. HISTORY OF THE MEETING

ii.1 PLACE AND DURATION OF THE MEETING

At the invitation of Civil Aviation Authority of Chile (DGAC), RLA/00/009 Project Coordination Meeting on GNSS Augmentation Trials was held in Santiago, Chile. The meeting commenced on 1 August and ended on 3 August 2001.

ii.2 OPENING CEREMONY

Mr. José Miguel Ceppi, ICAO Deputy Regional Director of the South American, addressed the meeting on the work expected and called on all the States to give their full support in order to successfully conclude the Agenda of the Meeting.

Coronel (Av.) Luis Lli Salgado, Director of Planning, welcomed all participants and expressed his pleasure in hosting this event and wished the meeting success on its deliberations.

ii.3 ORGANIZATION, OFFICERS AND SECRETARIAT

The meeting was chaired by Mr. Luis A. Rossi. Mr. Onofrio Smarrelli, SAM Regional CNS Officer, acted as Secretary of the Meeting, and was assisted by Mr. José Miguel Ceppi, ICAO DEPRD,.

ii.4 WORKING LANGUAGES

The working languages of the meeting were Spanish and English. The documentation and the Report of the Meeting were issued in English and Spanish.

ii.5 AGENDA

The Meeting approved the Agenda as it was presented.

Item 1 Analysis of the system for the GNSS augmentation trials, reference stations, master stations, avionics equipment and network configuration

Item 2 Analysis of the activities contemplated in the GNSS Regional Augmentation Project

Item 3 Schedule of activities to be carried out

Item 4 Any other business

ii.6 **ATTENDANCE**

The Meeting was attended by 8 CAR/SAM States, and COSESNA.

ii.7 **WEB SITE**

The documentation presented to the meeting including the Summary of Discussions and Conclusions are available at http://www.lima.icao.int/

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Agenda Item 1: Analysis of the system for the GNSS augmentation trials, reference stations, master stations, avionics equipment and network configuration

1.1 Under this Agenda item, the Meeting was informed on aspects related with the list of counterpart coordinators of RLA/00/009 project, on the actions carried out by each of the States where the reference stations will be installed, the configuration of the communications platform to support the augmentation trial, as well as the avionics equipment necessary for the trials.

1.2 The Meeting took note that all States involved in the project had established multidisciplinary groups for the execution of the trial and had assigned the people who would act as chief of group and counterpart for its execution. **Appendix A** to this part of the report presents an updated list of the State coordinators involved in the trial, and who will act as project counterparts.

1.3 Likewise, the Meeting was informed on the actions carried out by the States involved with regard to the installation of the reference stations, such as coordination for the temporary importation of the equipment and the preparation of the site where the respective equipment will be housed.

1.4 The Meeting decided that, to avoid difficulties which might present themselves with regard to the temporary importation of the reference station equipment, the ICAO Regional Office would send the respective UNDP offices the letter of agreement between the FAA and ICAO for the execution of the project, so it could be used to speed the process. Moreover, the FAA would provide information to each State referring to the model, serial number and number of packages, with indications of weight and size of the equipment to be sent.

1.5 The Meeting took note that the reference stations should be installed before 30 September 2001 and, therefore, all arrangements specified in the above paragraphs had to be accommodated to that date.

1.6 The United States delegation presented the Meeting with the configuration of the reference station, explaining each of its parts. **Appendix B** to this part of the report shows a block diagramme of same.

1.7 The Meeting noted the information presented on the communications platform that will support the GNSS augmentation trials, which is presented in **Appendix C** to this part of the report. The configuration shows the sites where the reference stations and the master stations will be located and the communications links with the minimum band width requirements.

1.8 From this Appendix, it can be noted that to link the reference stations with the master station, communications circuits with a minimum band width of 19.2kb/sec are required. The reference stations of Colombia and COCESNA will connect with the Rio de Janeiro master station together with all of Brazil's reference stations (Brasilia, Curitiba, Manaus, Recife and Rio de Janeiro). Likewise, the Argentina, Bolivia and Peru reference stations will be connected to the Santiago de Chile master station, together with the other reference stations in Chile (Antofagasta, Balmaceda and Santiago).

1.9 In order that each of the master stations can administrate all of the Project's reference stations, the Meeting informed that it would be necessary to establish a 128Kbits/sec minimum capacity communications link between them. This way, each of the master stations would be able to transmit all necessary information to the ground station in charge of establishing the satellite link.

1.10 The Meeting agreed with the aforementioned configuration, and the delegate from Brazil highlighted the importance in the establishment of links between the two master stations. The Chilean representative indicated that, since this link had not been originally foreseen in the project, its establishment had to be first consulted with his authorities, and that the Lima ICAO Regional Office would be provided with a reply in this regard not later than 30 August 2001.

1.11 The Meeting took note that the reference station originally planned to be installed in Bogota could be changed to a new location, still to be determined by the Colombian Administration but not later than 10 August 2001.

1.12 The Meeting noted that the establishment of the satellite uplink to be provided by Brazil with the INMARSAT III F5 satellite would be available in the third quarter of 2002, fact which would not guarantee the regional augmentation trials until that date. Therefore, it was initially agreed that the augmentation message would be disseminated via VHF. In this respect, the representative from Chile offered at the project's disposal, the VHF (Tx/Rx) equipment necessary for the trial. During the Meeting, knowledge was taken on the various manners to establish connections between the master station and the VHF transmitter.

1.13 The delegates from Colombia, Ecuador and COCESNA indicated their interest in equipping their aircraft with the GPS WAAS experimental equipment and, therefore, would carry out the necessary arrangements with the FAA to this end.

APPENDIX A

RLA/OO/OO9 PROJECT COUNTERPART COORDINATORS

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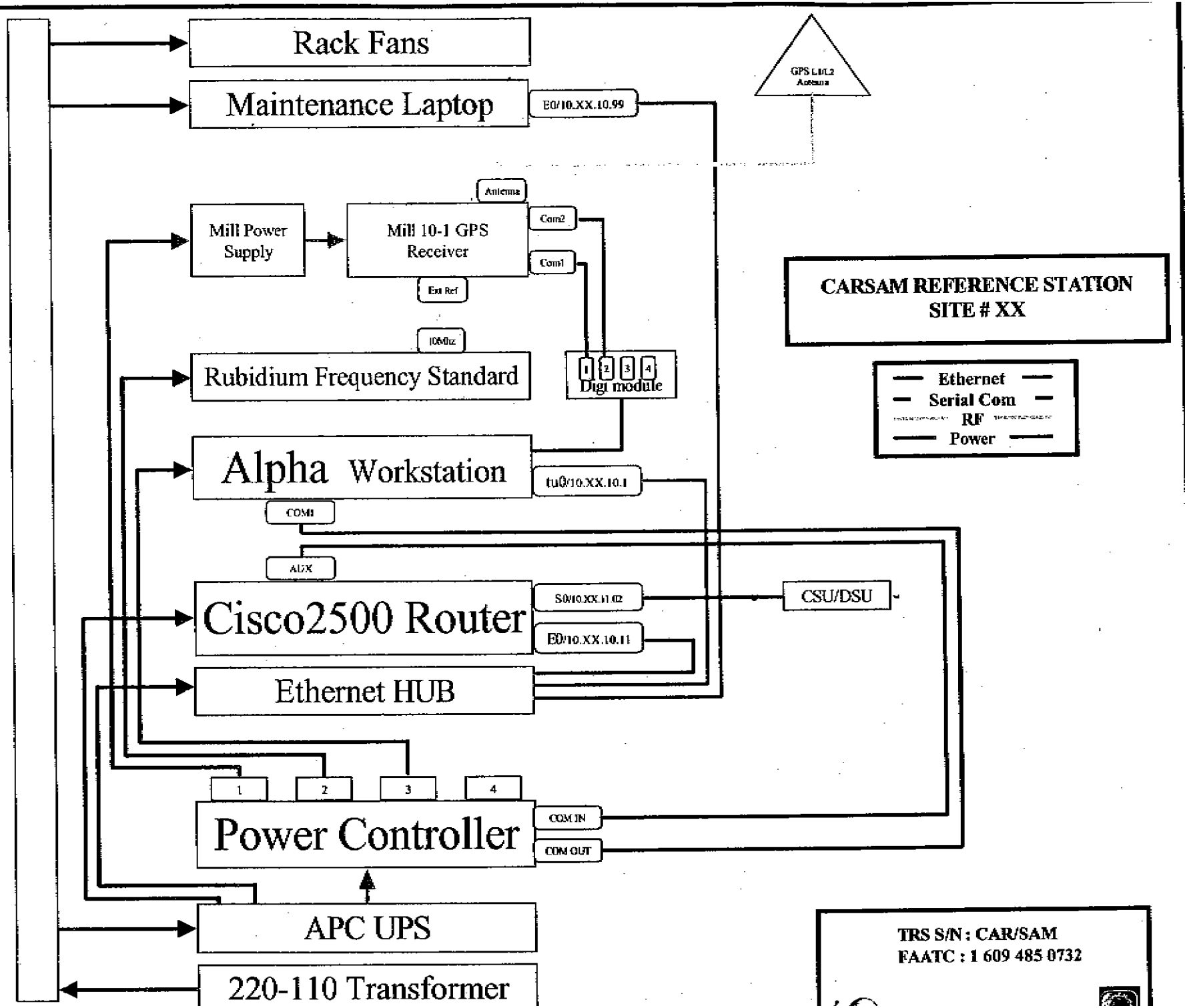
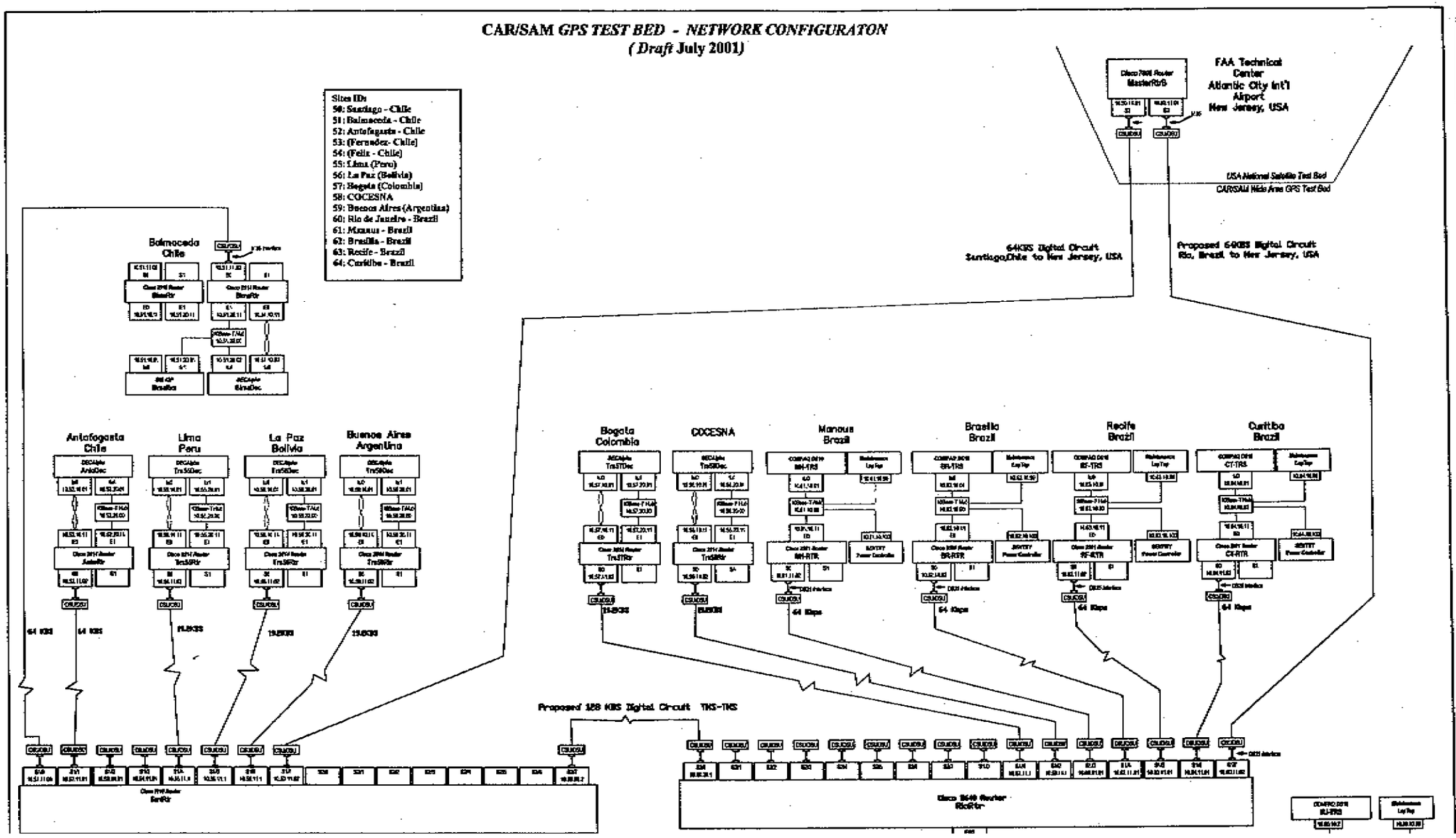

Rack Fans
Maintenance Laptop
E0/10.XX.10.99
GPS L1/L2 Antenna
Antenna
Mill Power Supply
Mill 10-1 GPS Receiver
Com2
Com1
Ext Ref
10Mhz
Rubidium Frequency Standard
1 2 3 4
Digi module
CARSAM REFERENCE STATION
SITE # XX
Ethernet
Serial Com
RF
Power
Alpha Workstation
tu0/10.XX.10.1
COM1
AUX
Cisco2500 Router
S0/10.XX.11.02
E0/10.XX.10.11
CSU/DSU
Ethernet HUB
1
2
3
4
Power Controller
COM IN
COM OUT
APC UPS
220-110 Transformer
TRS S/N : CAR/SAM
FAATC : 1 609 485 0732


CAR/SAM GPS TEST BED - NETWORK CONFIGURATON
(Draft July 2001)
Sites IDs
50: Santiago - Chile
51: Balmaceda - Chile
52: Antofagasta - Chile
53: (Fernandez- Chile)
54: (Felix - Chile)
55: Lima (Peru)
56: La Paz (Bolivia)
57: Bogota (Colombia)
58: COCESNA
59: Buenos Aires (Argentina)
60: Rio de Janeiro - Brazil
61: Manaus - Brazil
62: Brasilia - Brazil
63: Recife - Brazil
64: Curitiba - Brazil
FAA Technical Center
Atlantic City Int'l Airport
New Jersey, USA
USA National Satellite Test Bed
CAR/SAM Wide Area GPS Test Bed
64KBS Digital Circuit Santiago,Chile to New Jersey, USA
Proposed 64KBS Digital Circuit Rio, Brazil to New Jersey, USA
Balmaceda Chile
Antofagasta Chile
Lima Peru
La Paz Bolivia
Buenos Aires Argentina
Bogota Colombia
COCESNA
Manaus Brazil
Brasilia Brazil
Recife Brazil
Curitiba Brazil
64 KBS
15.6KBS
Proposed 128 KBS Digital Circuit TNS-TNS

Agenda Item 2: Analysis of the activities contemplated in the GNSS Regional Augmentation Project

2.1 The Meeting took note that the main activity of the Project will be to collect data permitting to examine the precision and integrity parameters, as well as to execute a CAR/SAM Regional and State plan to carry out a flight test, with a navigation and satellite augmentation system (GPS/WAAS).

2.2 The Meeting examined and approved the State and regional objectives and trial plans specified in the RLA/00/009 project document, Appendices B and D, which were presented as appendices to working paper 3.

2.3 For the verification as to whether the results of the trials respond to pre-determined values on the availability of accuracy for en-route navigation, as well as on non-precision and precision approaches, the Meeting considered that the service volumes specified in Appendix H of the RLA/00/009 project document should be updated in accordance with the final GNSS augmentation configuration approved by the Meeting under Agenda Item 1 and, to that end, the FAA would proceed to its modification.

2.4 The United States delegate invited the CAR/SAM States involved in the project to participate in the work of the task force studying the effects of the ionosphere in the GPS signal, at which the FAA, Japan and States from other Regions, participate.

2.5 The Meeting considered that, due to the current lack of availability of the satellite based augmentation segment, the initial trials would be carried out in the terminal area flight phase (non precision approach and vertical guidance precision approaches), using the VHF aeronautical band for the transmittal of the corrections.

2.6 The Meeting was informed that the trials using satellite augmentation would be carried out as of the third quarter of 2002, date when the INMARSAT orbital geostationary satellite uplink would be available.

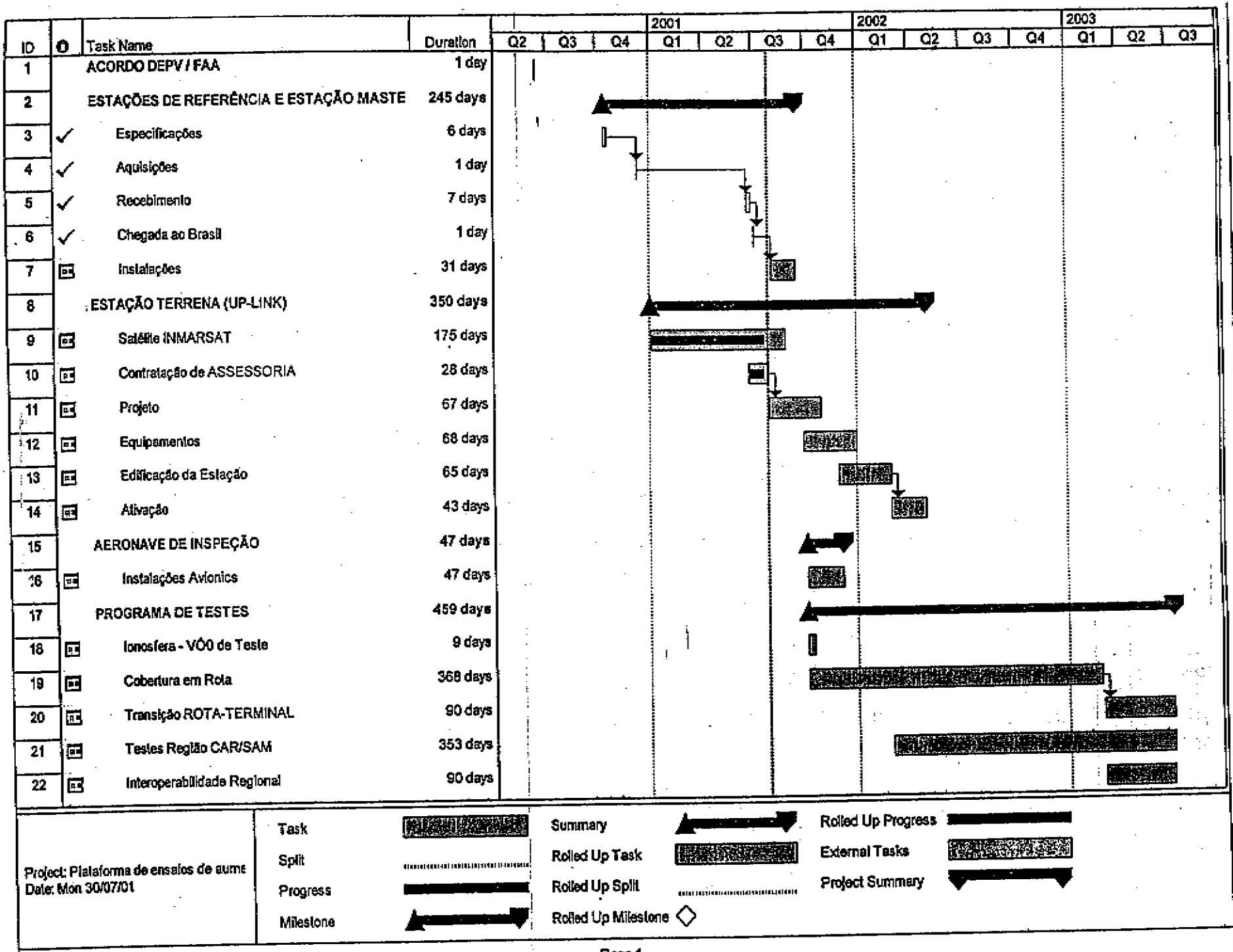
2.7 Moreover, the Meeting took note that the INMARSAT III F5 would not cover all of the CAR/SAM Regions, having a better signal availability in the southern part of South America. Therefore, Brazil carried out arrangements with INMARSAT to have space availability in the fourth generation of satellites that would be in activity by the year 2004, which would have complete coverage for the CAR/SAM Regions.

2.8 The Meeting was made aware that the terminal area flight phase trials would start in November 2001, and was informed that Brazil, between 6 and 17 October 2001, would be carrying out trials with the FAA for the analysis of the GPS signal, since during those dates variations would occur in the ionosphere due to a great activity of solar stains, cyclic phenomenon that appeared every eleven years. **Appendix A** to this part of the report presents the chronogram of activities for the implementation of the trial system corresponding to Brazil.

2.9 Moreover, the Meeting was informed that Brazil would hold a seminar, related with the ionospheric effects on GPS signals, immediately after the dates indicated in the above paragraph and, to that end, would extend an invitation to all CAR/SAM States, through the ICAO Regional Office.

2.10 The Meeting took knowledge on the establishment of a satellite forecasting software that the Chilean CAD will install in 23 aerodromes and airports of the country. This software will permit crew to know, prior to a given flight, satellite availability at the various flight phases between pairs of cities.

2.11 During the Meeting, some observations presented in Appendix A to working paper 7 were presented, related with an amendment to RLA/00/009 project document, which were taken into consideration by the Secretariat for their corresponding correction.


ID
Task Name
Duration
2001
2002
2003
Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3
1 ACORDO DEPV / FAA 1 day
2 ESTAÇÕES DE REFERÊNCIA E ESTAÇÃO MASTE 245 days
3 Especificações 6 days
4 Aquisições 1 day
5 Recebimento 7 days
6 Chegada ao Brasil 1 day
7 Instalações 31 days
8 ESTAÇÃO TERRENA (UP-LINK) 350 days
9 Satélite INMARSAT 175 days
10 Contratação de ASSESSORIA 28 days
11 Projeto 67 days
12 Equipamentos 68 days
13 Edificação da Estação 65 days
14 Ativação 43 days
15 AERONAVE DE INSPEÇÃO 47 days
16 Instalações Avionics 47 days
17 PROGRAMA DE TESTES 459 days
18 Ionosfera - VÔO de Teste 9 days
19 Cobertura em Rota 368 days
20 Transição ROTA-TERMINAL 90 days
21 Testes Região CAR/SAM 353 days
22 Interoperabilidade Regional 90 days
Project: Plataforma de ensaios de aume
Date: Mon 30/07/01
Task
Split
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Split
Rolled Up Milestone
Rolled Up Progress
External Tasks
Project Summary
Page 1

Agenda Item 3: Schedule of activities to be carried out

3.1 The meeting took note that the execution of the project would basically be the installation of reference stations (TRS), the corresponding training and the execution of all regional and national trial-related activities.

3.2 Moreover, it was informed that the memorandum of understanding between the FAA and ICAO for the execution of RLA/00/009 was signed on 4 June 2001. This memorandum establishes the terms and conditions for the loan of the equipment necessary at the reference stations, its installation and provision of other resources for investigation and development purposes.

3.3 The memorandum specifies that FAA will loan five single-strand NSTB reference stations, which, before remittance to the respective States shall be stored at the FAA William J. Hughes Technical Center in Atlantic City, New Jersey, United States.

3.4 Likewise, the memorando indicates that, for the installation of the reference stations, the FAA will provide four qualified specialists to perform the following activities on no more than two temporary duty assignments:

a) Demonstrate the installation of a reference station at a site designated by ICAO (Buenos Aires, Argentina);

b) Assist in the installation of the remaining reference stations; and

c) Provide the information necessary for the installation, operation and maintenance of the reference stations.

3.5 With respect to training, the memorandum specifies that the FAA will provide five qualified specialists to conduct two training courses on the operation and maintenance of the reference stations and on the implementation of GNSS. Additionally, training shall be provided with regard to installation of the reference station (paragraph 3.4.a)).

3.6 The Meeting, after an ample debate, decided that the chronogram in **Appendix A** to this part of the report would be taken into consideration as a basis for the development of a Gantt diagramme, in which all activities to be considered and the resources necessary for the project's execution would be taken into account. This will be developed before 30 August 2001 by the administrator of the project, assisted by the parties involved in the RLA/00/009 project.

3.7 The Meeting noted that the availability of the Chilean aircraft would only be possible during the course of 2001, due to budgetary restrictions for its use at another fiscal year.

3.8 Therefore and taking into consideration the initially all reference stations would have to be installed before 30 September 2001, the Meeting unanimously decided the establishment of short-term trials, to be carried out between 15 November and 15 December 2001 in Argentina, Bolivia and Peru. Due to the aforementioned, the Meeting formulated the following Conclusion:

Conclusion 3/1 - Execution of flight trials in Argentina, Bolivia and Peru

That:

a) Argentina Bolivia and Peru carry out all the activities indicated in the verification list presented as **Appendix B** to this part of the report, to guarantee the execution of the flight trials planned for the period between 15 November and 15 December 2001; and

b) Chile carry out the scheduling of the trial at the indicated date for its remittance to the project administration and States involved.

3.9 The Meeting was informed of the current situation of the project with regard to States contributions for the year 2001. In this regard, Argentina, Bolivia, Colombia and Ecuador informed they had already made the corresponding deposit. With the aim that all States involved in the project make their respective contributions in order not to affect its activities, the Meeting approved the following conclusion:

Conclusion 3/2 - State contributions to RLA/00/009 Project

That States involved in RLA/00/009 Project that have still not deposited their corresponding contributions, should do so as soon as possible and before 31 August 2001, so as not to affect the activities of the project.

3.10 The Meeting acknowledged the offer from Colombia to use an aircraft equipped with GPS/WAAS avionics for the RLA/00/009 project. The Meeting thanked the offer made by the representative from Colombia and agreed that this would be added to the document project, in the same manner as the offers made by Brazil and Chile had been.

APPENDIX A

PROGRAM SCHEDULE: RLA/00/009 PROJECT

PHASE 1: INSTALLATION OF THE CAR/SAM TEST BED REFERENCE STATION (CSTB) (JUNE – OCTOBER 2001)

Activities	Activities Dates	Remarks
Adherence of States to the RLA/00/009 States that have confirmed the participation to UNDP.	1 June 2001	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Panama, Paraguay, Peru, Uruguay, Venezuela, COCESNA, Cuba and USA. Argentina, Bolivia, Brazil, Chile, Colombia, Panama and Peru.
Signature of the Memorandum of Understanding NAT-I-9015	4 June 2001	Memorandum of understanding between FAA and ICAO for the execution of the RLA/00/009 project.
Storage of the CSTB equipment.	15 August 2001	Five (CSTB) will be available at the FAA Technical Center of Atlantic City. 2 complete racks (Argentina and Colombia) 3 racks without receiver (Bolivia, Peru, COCESNA.)
Shipment of the CSTB to locations participating in the test.	16 August 2001	The locations will be Argentina, Bolivia, Colombia, Peru and COCESNA.
Preparation of the sites	15 August 2001	The site preparation will be in Argentina, Bolivia, Colombia, Peru and COCESNA.
Implementation of the communication lines.	1 September 2001	That implementation will depend of the action made by the Aeronautical Administration with the communication service providers.

Activities	Activities Dates	Remarks
Coordination Meeting	1 - 3 de August 2001	The meeting will be in Santiago (Chile). The agenda of the meeting is related principally with the revision of all the activities necessary to carry out the project.
Installation of the first CSTB and Training. The first installation will be in Argentina.	5-7 September 2001	The FAA will carry out these activities. During that event, the technicians from the State involved will be trained in the equipment and on the form to make the installation of the CSTB.
Installation of all CSTB	30 September 2001	At that date we expect the culmination of the installation of all the CSTB.

PHASE 2: TRAINING PROGRAM (SEPTEMBER 2001- MARCH 2002)

Activities	Activities dates	Remarks
Course 1 Installation of a CSTB	Buenos Aires, Argentina, 5-7 September 2001	The States involved will be acquiring all the tools necessary to make a CSTB installation.
Course 2 WAAS functioning. Performing data reduction and analysis.	FAA Technical Center Atlantic City, 3-7 December 2001	The participants will be acquiring the necessary knowledge to understand the WAAS functioning. At the same time they will take note of the interpretation and analysis of the processing data of the augmentation system.
Course 3 Operational Requirements	Brazil, Rio de Janeiro, 11-15 November 2002	In this course the participants will take knowledge about the form to make operational procedures with GNSS.

PHASE 3: TEST EXECUTION (JANUARY - NOVEMBER 2002)

Activities	Activities dates	Remarks
Identification of the specific test and evaluation in a Regional context.	January 2002	Regional identification and evaluation for the specifics tests. Definition of the quantifiable measure of success. Development of a regional test schedule.
Execution of the Regional Test Plan.	June 2002	Complete the specific testing and demonstration objectives for the Regions.
Regional flight test report.	August 2002	Preparation of a report on detailed test results and analysis for the Regional flight test, showing how each objective has been successfully demonstrated for the Region.
Identification of the specific test and evaluation in a State context.	January 2002	Identification of the specifics objectives for test and evaluation in each of the participating States. Definition of the quantifiable measure of success. Development of a test schedule.
Execution of the States test plans.	August 2002	Complete the specific testing and demonstration objectives in each of the participating States.
States flight test report.	September 2002	Preparation of a report on detailed test results and analysis for each States, showing how each objective has been successfully demonstrated for the Region.
Final analysis of the Regional and States flight test.	November 2002	The final analysis will permit to define the strategies for the operational implementation in the CAR/SAM Region.

APENDIX B

LIST OF ACTIVITIES TO CARRY OUT

CHECK LIST

1. Temporary entrance of the reference station at the respective States;
2. Determine antenna site installation in WGS-84 coordinates for the reference station. Record of the GPS signal for a period of 4 to 5 hours in the Ashtech receiver;
3. Installation of the reference station;
4. On the job training related with the installation of the reference station;
5. Start of operation of the reference station;
6. Get ready the communication link with the master station;
7. Link the reference station with the respective master station;
8. Verify transmission and reception;
9. Determine in WGS-84 the coordinates for the Touch Down Zone (TDZ). It is convenient to remember that the quality of the coordinates will determine the success of the test. Take into account that these coordinates will be the data that will be entered in the GPS/WAAS avionic of the plane for the flight inspection;
10. Make the coordination with the respective organism for the assignment of a frequency in the VHF aeronautical band;
11. Each State involved in the test will permit the plane used for flight test the respective permission for over flight and arrival;
12. The plane that will participate in the test will be exempt of taxes and aeronautical laws in each of the respective States; and
13. Each State will be providing the respective approach charts.

ACTIVITIES TO CARRY OUT BEFORE THE FLIGHT

1. Determine the WGS-84 point in which the GPS Ashtech receiver will be recording the data. This will be one of the files that will be used in the procedure of data reduction and after that will determine the GPS/WAAS error; and
2. To coordinate and inform the Air Traffic Services that a simulated instruments approach will be made under the rules of VFR flight.

PROCEDURE TO CARRY OUT DURING THE FLIGHT

1. Turn on the GPS Ashtech receiver that will stay on ground;
2. Turn on the GPS Ashtech receiver in the avionics rack;
3. Turn on the GPS/WAAS avionics previously configured with the TDZ and the receiver for the transmitted VHF correct message;
4. Begin with the taxi of the plane. In the meantime the data will be recorded in the receiver on ground, at board and at the avionics;
5. The plane is directed through the initial point of approach and intercepts final trajectory. Will continue the data recording;
6. In the Decision Height (DH), it will make a low cross on the runway, climbing to carry out a new approach;
7. According with the obtained experience, 3 to 4 flights are foreseen, with a total of 12 approaches; and
8. The Citation II carries 6 passengers and the crew is composed by 2 pilots and one on board flight inspector.

Agenda Item 4: Other matters

4.1 The Meeting considered it necessary to hold another meeting of the Coordination Group for mid 2002, which would be coordinated to be executed together with the activities of the Navigation Task Force of the CNS Committee. In this respect, the Brazilian delegation informed the Meeting its with to be host State for the next meeting of the Coordination Group.

4.2 Likewise, the Meeting took note of the importance in the use of electronic mail for the exchange of information among the members of the coordination group, as well as of the use of the mailing list.

4.3 The Meeting acknowledged the request from Colombia to be incorporated into the Technical Committee of the Navigation Task Force, considering it convenient.

4.4 Moreover, the Meeting was informed that a seminar on implementation of CNS/ATM systems would be held in Bogota, Colombia, from 10 to 14 September 2001.