*International Civil Aviation Organization* SAM/IG/9-WP/07
South American Regional Office 23/04/12
*Assistance in the implementation of an ATM regional system according to the ATM operational concept and the corresponding technological CNS support*
**Ninth Workshop/Meeting of the SAM Implementation Group (SAM/IG/9) - Regional Project RLA/06/901**
Lima, Peru, 14 to 18 May 2012

**Agenda Item 6: Assessment of operational requirements in order to determine the implementation of communications and surveillance (CNS) capabilities improvement for en-route and terminal area operations**

# FOLLOW UP TO THE IMPLEMENTATION OF THE NEW REGIONAL DIGITAL NETWORK REDDIG II

(Presented by the Secretariat)

**SUMMARY**

This working paper presents information on the REDDIG II implementation activities, as well as an updating to the action plan examined during SAM/IG/8 meeting.

**REFERENCES:**

- Report of the eighth workshop/meeting of the SAM Implementation Group (SAM/IG/8) (Lima, Peru, 10-14 October 2012); and
- Report of the fourteenth meeting of the REDDIG Coordination Committee (Lima, Peru, 16-18 March 2011).

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| ***ICAO strategic objectives:*** | *A – Safety*<br>*C - Environmental Protection and Sustainable Development of Air Transport* |

## 1. Background

1.1 SAM/IG/8 meeting, taking into account the results of the Seminar/Workshop on New Technologies in Satellite and Ground Networks (Lima, Peru, 18-20 July 2011) and the approval by the twelfth meeting of Civil Aviation Authorities of the SAM Region (RAAC/12) (Lima, Peru, 3-6 October 2011) to start with the bidding process for the implementation of REDDIG II, carried out a review to the action plan for the implementation of REDDIG II.

## 2. Analysis

2.1 As part of the REDDIG II action plan activities, the REDDIG technical specifications were reviewed by its member States, the REDDIG Administration and the ICAO Technical Cooperation Bureau (TCB). The revised REDDIG technical specifications document is shown in **Appendix A** to this working paper.

2.2 The technical specifications document was uploaded in the ICAO TCB Purchasing Section, www.icao.int/procurement, on 4 April 2012. As part of the coordinations between the REDDIG Administration and the ICAO TCB, a chronogramme of activities for the bidding phase was established, which includes a cycle of questions from the companies participating in the biddding, the respective answers from the REDDIG Administration, the compulsory visit of the bidders to the REDDIG nodes, the drafting of the offer assessment criteria, and the development of the fifteenth meeting of the REDDIG Coordination Committee (RCC/15), which would endorse the revision results and the selection of the bid winner. In this respect, the action plan for REDDIG II implementation was amended, which is shown in **Appendix B** to this working paper. This same Appendix B presents updated information on the REDDIG II implementation process.

## 3. Action suggested

3.1 The Meeting is invited to:

a) Take note of the information provided in the working paper;
b) Analyze the REDDIG II action plan, in Appendix B to this working paper; and
c) Analyze other aspects related with this Agenda Item that the Meeting might consider necessary.

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**APPENDIX A / APENDICE A**

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| | **INTERNATIONAL CIVIL AVIATION ORGANIZATION**<br>**TECHNICAL CO-OPERATION BUREAU**<br>**TECHNICAL SPECIFICATION** | **THIS COLUMN TO BE COMPLETED BY TENDERER**<br><br>**COMPLIANCE STATEMENT** |
| ***ICAO SPECIFICATION CODE***: 15-80-300 RLA/03/901 PR 21100852 15 MARCH 2012 | | Tenderer **must** state below, against **every** item, ***Compliance*** or ***Non Compliance***. Failure to complete and return this form may invalidate the bid. |
| ***TITLE:*** **REDDIG II IMPLEMENTATION PROJECT** | | |
| ***It is strictly prohibited for tenderers to alter this document. Only the originator of the specification may provide amendments.*** | | SUPPLIER NAME: |
| **SECTION A – INTENT AND STANDARDS** | | |

## 1. OBJECTIVE

1.1 The International Civil Aviation Organization (ICAO), on behalf of the Governments of Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, French Guiana, Guyana, Paraguay, Peru, Suriname, Trinidad &Tobago, Uruguay and Venezuela ***intends to procure, on a turnkey basis, the new transportation network of the Regional Aeronautical Telecommunication Network envisaged in the ICAO CNS/ATM concept, through two backbones (one satellite, one ground) to be installed one at each country, except Brazil that requires three, and all Ancillary Equipment and Services (including Training) and all related Civil Works.***

## 2. OBJECTIVE OF REDDIG II

2.1 The objective of the new digital network of the region (*hereinafter REDDIG II*) is to **establish the new transportation network of the Regional Aeronautical Telecommunication Network** envisaged in the ICAO CNS/ATM concept, through two backbones (one satellite, one ground) to be installed one at each participant country, except Brazil that requires three.

2.2 In order to achieve this objective, the aeronautical authorities of the Region have agreed that the REDDIG II shall **ensure**:

a) To have router devices, equipment and satellite links, as well as ground services, with all the channel interfaces that exist in the current network, incorporating those that might be required to support the future services based on the aforementioned concept.
b) Generalised application of the IP protocol in the transportation network for voice and data aeronautical communications.
c) The establishment of the appropriate service quality parameters.
d) That analogue services are maintained where so required (AFTN, radar data from old equipment, etc.).
e) That the connection to the MEVA II network is maintained.
f) To maintain a centralised and common network management.

| SECTION A – INTENT AND STANDARDS | |
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g) That the high level of availability attained by the current REDDIG is maintained.
h) That it is the regional means of integration of domestic networks developed by the Sates of the Region.
i) Cost-effective support to regional communications, with a high level of reliability, availability and minimum delay.

**3. SCOPE**

3.1 The Project contemplates that the Successful Bidder shall **provide**:

3.1.1 The following **items** in each of the REDDIG nodes:
a) The routing system with the appropriate interfaces;
b) The VSAT satellite terminal;
c) The network management system (NMS);
d) The stock of spare parts;
e) The specialised testing tools and equipment recommended by the manufacturer;
f) Training, installation, system operation and maintenance manuals, and technical documentation for the installation.
g) Other items required for ensuring proper installation, operation and maintenance of the network.

3.1.2 The following **services**:
a) Site surveys prior to installation;
b) Engineering and system documentation;
c) Civil works;
d) Installation of the satellite system supplied;
e) Coordination with the ground service provider, if other than the Successful Bidder, for the installation of the MPLS service;
f) Personnel training;
g) Testing of the satellite system supplied;
h) Start-up of the satellite system supplied;
i) Implementation of the MPLS ground backbone;
j) Automatic integration of ground and satellite mediums;
k) Other services required for ensuring proper installation, operation and maintenance of REDDIG II.
l) Payment for MPLS services and the satellite segment during the first six (6) months of operation of the new network, if it is decided not to use the current satellite that provides such segment to the REDDIG (IS-14).
m) The technical guarantee for the established period.

3.1.3 The project will be implemented as a turnkey project.

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### 4. BASIC TECHNICAL CHARACTERISTICS OF THE NETWORK

4.1 REDDIG II shall have the following minimum characteristics:

a) Satellite and ground access.
b) Meshed, flexible, multi-protocol, multi-service and external area topology.
c) Scalable and easily expandable.
d) Redundancy and satellite and ground routings.
e) Open architecture, based on IP protocol.
f) Permits the migration to other network technologies.

### 5. GENERAL CONSIDERATIONS

5.1 *The Successful Bidder shall be responsible for the design, acquisition, transport, installation and commissioning of the required equipment and services, with all the accessories and facilities, as well as the documentation and training of national technicians, in addition to the provision of spare parts and the required repair services.*

5.2 The system shall be installed in the existing equipment rooms; consequently, the equipment installed by the Successful Bidder shall be suited to fit in the operational environment of the Area Control Centres of the Region.

5.3 Each AAA shall:

a) Provide the physical space for the installation of cabinets and equipment. The Bidder shall identify the exact locations during the site survey.
b) Deliver to the premises the electric power required to feed the equipment to be provided by the Successful Bidder. The latter will be responsible for providing the accessories, safety switches, cables, connections between the main distribution panel and the equipment provided.
c) Provide access to the equipment to be connected to the REDDIG II for the required cabling.

### 6. RULES AND STANDARDS

6.1 All designs, materials, manufacturing techniques and workmanship shall be in accordance with the highest accepted international standards for this type of equipment, including the construction, building codes and electrical standards for all civil works.

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6.2 Where applicable, the equipment shall fully comply with or exceed the requirements of the following documents (latest edition plus any related amendments):

a) the standards and recommended practices of the International Civil Aviation Organization (ICAO) contained in the Annexes, as well as the provisions of its manuals, documents and circulars concerning aeronautical telecommunications, the ATN, CNS/ATM systems, and air traffic services. The Successful Bidder is responsible for complying also with the new standards, amendments and recommendations issued during the implementation of the project;

b) the standards and recommendations of ITU-T, ITU-R and radio communication appendices and regulations. Regarding ITU-T recommendations concerning networks and circuits that take into account both US and European standards, the European standards shall apply, unless otherwise specified;

c) the International Organization for Standardization ISO/IEC standards;

d) the ECMA, ETSI, IETF/RFC, EIA/TIA, IEC, NFPA/NEC, UL, ANSI/EIA standards;

e) those applied by public carriers in each State; and

f) the standards of the satellite provider (applicable SSOG and IESS standards);

g) RTCA documents inasmuch they supplement and clarify ICAO recommendations or this specification;

h) the standing telecommunication rules and the corresponding regulations of each State where REDDIG II equipment will be installed. If required, the Successful Bidder will be responsible for certifying the equipment with the appropriate authority under the existing regulations;

i) the ISO 9000 certification in terms of its methods and lines of production. Compliance with ISO 14000 standards is desirable in terms of materials, installation process, maintenance and disposal of materials.

6.3 *If at the time of the publication of this document the specific rules and standards mentioned in any of the other Sections have been revoked, superseded or updated, the new rules or standards shall be deemed as applicable.*

6.4 The Bidders shall pay special attention to minimising manual operations and maintenance tasks, and to the expansion capacity of the system, for both electronic and electrical components.

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| 6.5 In order to achieve these objectives, the use of standard and COTS (commercial off-the-shelf) materials and equipment from manufacturers engaged in their production shall be maximised.<br><br>6.6 The use of modular techniques in the design and manufacturing of hardware should be maximised. Assemblies shall use "plug-in" modules with easily interchangeable parts.<br><br>6.7 Equipment shall be described in the metric system (MKS units, *i.e.*, metres, kilogrammes and associated scales).<br><br>6.8 Likewise, considering that available networks and facilities of ground service providers will be used, the Bidder shall take into account the interconnection, availability and reliability standards of such networks in order to supply the appropriate equipment that will ensure a proper provision of the service.<br><br>6.9 Furthermore, the supply shall consider all the compatibility aspects required for connecting and operating satisfactorily with the existing equipment, networks, sub-systems and systems of civil aviation authorities (AAA) and telecommunication service providers.<br><br>**7. ALTERNATIVES**<br><br>7.1 Bidders are invited to bid for any equipment that, in their opinion, meets, or exceeds the requirements of, this specification. Any such alternative or variation shall be fully and clearly defined and substantiated so as to easily determine such equivalence or superiority.<br><br>7.2 The Bidder shall also clearly indicate the extent to which the requirements of this specification are not in conflict with the alternate design, and shall indicate the performance it can guarantee where it differs from that defined herein.<br><br>**8. BIDDER'S EXPERIENCE**<br><br>8.1 The Bidder shall demonstrate broad experience in the engineering, supply, installation and commissioning of networks and systems that are similar to those requested in this document. The Bidder shall include a list of customers to whom it has supplied and installed, during the last five (5) years, networks similar to those offered in its technical proposal and that are currently in operation. The list shall contain the names, addresses and references of customers that can be contacted. | |

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8.2 The Bidder shall submit at least three (3) letters of reference with the contact names of different customers with similar projects in different locations to enable verification of the level of compliance and quality of the equipment and services previously provided. ICAO or the AAA may visit such customers to check the accuracy of the information submitted.

8.3 The Bidder shall demonstrate that the level of quality of its personnel is commensurate to the installation, commissioning and maintenance of the systems and services to be supplied and installed.

8.4 The system manufacturer shall be a leading company worldwide, with a technology proven and recognised in the international markets. In this sense, Bidders shall also indicate the country of manufacture of the proposed equipment.

### 9. BIDDER'S DOCUMENTATION

9.1 ***Statement of compliance: all bids shall be accompanied by a Statement of Compliance, in the form of a copy of the specifications, indicating in the right column whether it Complies (C) or Does not Comply (NC). If the bid states that it complies, any reference, indication, comment or subsequent note to the contrary shall not release the Bidder from the responsibility for the compliance stated.*** The Bidder shall make reference to the statement of compliance, indicating what section of its documentation substantiates such statement. Failure to provide such definitive indication with respect to any requirement can invalidate its bid.

9.2 The Bidder shall submit its bid in Spanish and English, in two (2) hard copies and one (1) electronic copy. See Section D, Technical Documentation for further details. The official language of the tender will be English.

9.3 Each Bidder shall submit the appropriate technical documentation containing data sheets, performance data, drawings, illustrations, pictures, etc., of the system being offered to enable full and detailed assessment of the bidder as a whole, in accordance with that stated in Section C.

*Note*.—The submittal of supporting brochures and bibliography is highly recommended, and in many cases it contributes to illustrate the characteristics of the product, but it does not release the Bidder from the need to fully complete the statement of compliance required above.

| SECTION A – INTENT AND STANDARDS | |
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| 9.4 The financial bid shall provide detailed costs of the equipment and services required in this technical specification. | |
| 9.5 The proposal shall include documentation on operational commands, preventive and corrective maintenance routines, failure analyses and other information that the Bidder may deem appropriate. | |
| 9.6 The Bidder shall provide an itemised list of costs of spare parts, accessories, consumable items and installations. The Bidder shall provide the necessary instructions for assembly, operation and maintenance, and a list of elements and accessories to be provided for the implementation of the system to be contracted. | |
| 9.7 The Bidder shall submit, together with its bid, a timetable of major activities to be carried out concerning the design, manufacturing, provision, FAT, installation, on-site training, site acceptance and commissioning (see other details in Section E). | |
| 9.8 Additionally, the Bidder shall submit the available technical manuals (as described in Section D) as part of the proposal. | |

## SECTION B – GENERAL REQUIREMENTS

### 1. REQUIREMENTS APPLICABLE TO BOTH BACKBONES (GROUND AND SATELLITE)

### 1.1 General guidelines

1.1.1 The Bidder may be required to provide the organizational chart of the company and resumes of its technical staff.

1.1.2 The Bidder shall prepare a project and assembly timetable for all electronic equipment of the satellite backbone equipment.

1.1.3 The Successful Bidder shall be fully responsible for the design, selection of components and materials, and installation techniques, to ensure total integration and full compatibility between the main components and all auxiliary units, and to provide suitable training to both technical and operational staff, to ensure successful operation of all supplied equipment and services.

1.1.4 Within forty-five (45) days following the signing of the contract, the Successful Bidder shall submit for the approval of ICAO a detailed System Design Document (SDD) for the implementation of the satellite and ground MPLS backbones, taking into account their integration. The document must contain all design details, equipment location, plan drawings, rack layouts, drawings, civil works, and all other information required for the proper installation and commissioning of the system.

1.1.5 The Successful Bidder shall appoint properly qualified personnel in sufficient number to perform the work within the proposed timeframes.

1.1.6 The Successful Bidder shall prepare and submit Factory Acceptance Test (FAT) procedures for approval, and shall conduct the performance tests before shipment the equipment.

1.1.7 The Successful Bidder shall obtain all the necessary permits for civil works, power supply, and local telecommunications, as well as any other approval from the regulatory agencies.

1.1.8 The Successful Bidder shall prepare and submit the Site Acceptance Test (SAT) protocols for approval.

1.1.9 The Successful Bidder shall be responsible for storing the equipment before its installation. Subsequently, the Successful Bidder shall provide on-the-job training (OJT) for national technical staff, prior to the PSAT.

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1.1.10 The Successful Bidder shall be held liable for any damage to existing property in each AAA.

1.1.11 The Successful Bidder shall keep the working area clean and free from fire hazards. After installation, all excess material shall be removed.

1.1.12 The Successful Bidder shall submit operating and maintenance manuals, as well as the final drawings showing how facilities were constructed.

1.1.13 The Successful Bidder shall proceed with PSAT, NAT and FSAT tests, and record all results as part of the final commissioning report.

**1.2 Input power supply**

1.2.1 The equipment shall be fed from a 110 - 240 VAC, 50/60 Hz ± 5% power supply source. For sites lacking UPS availability, the Bidder shall quote, as Optional, a unit with maintenance-free batteries of suitable capacity for the equipment to be provided for the node, with an autonomy of no less than one (1) hour, in case of primary AC power failure.

1.2.2 Any failure of the equipment to operate satisfactorily within the previously defined tolerances shall be clearly indicated. By default, the statement of compliance shall be taken as a performance guarantee.

1.2.3 The Successful Bidder will be responsible for the connection to the power supply in the installation site. The Bidder shall provide detailed costs of any wiring or conditioning required to ensure power supply availability on the site.

1.2.4 The Bidder shall give full consideration to potential power fluctuations and transients and thus shall provide and install protectors and/or surge arresters in sufficient number to achieve a high degree of protection.

**1.3 Environmental conditions**

1.3.1 The equipment and auxiliary units shall be designed for continuous operation under the following atmospheric conditions:

**Indoors**

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| Temperature: | $0^{o}$ C to $+40^{o}$ C |
| Relative humidity: | up to 90% ($0^{o}$ C to $+35^{o}$ C) |
| | 60% (> $+35^{o}$ C) |

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**Outdoors**

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| Temperature: | $-10^{o}$ C to + $55^{o}$ C |
| Relative humidity: | up to 95% |
| Wind speed: | up to 160 km/h |
| Elevation: | up to 4100 m |

1.3.2 The Bidder shall confirm these values.

**1.4 General considerations**

1.4.1 Convection cooling shall be effective as much as possible, and shall ensure that all components operate within their nominal values. If ventilation grids are required, these shall be duly protected with a wire mesh.

1.4.2 Proper precautions shall be taken to prevent a significant increase in the internal equipment cabinet temperature.

1.4.3 If built-in cooling fans are used in the equipment, they must be as silent as possible.

1.4.4 The Bidder shall determine if air conditioning is needed in the equipment room of the installation site. If additional air conditioning units are needed, the cost of the appropriate equipment and associated facilities shall be provided.

1.4.5 Weather conditions at some sites may have a highly corrosive effect on exposed equipment. All supplied equipment shall be of the *tropicalized* type and be protected against the entry of sand, salt, dust (up to 150 microns), insects, and humidity.

1.4.6 The Bidder shall indicate the process used to protect the equipment and also the level of protection provided.

1.4.7 The equipment and associated components shall be provided with lightning arresters.

**1.5 Protection system**

1.5.1 Protection methods shall follow the standard commercial practice of providing adequate preventive control against the most severe conditions.

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1.5.2 This can be achieved through a number of individual methods or a combination thereof, depending on the severity of the conditions, the nature of the equipment and of the various materials used in the equipment. The Bidder shall provide a brief description of each of the proposed methods.

1.5.3 The protection of electrical and electronic equipment shall be such as to make it particularly resistant to damages caused by humidity, high and low environmental temperatures, dust, insects, corrosive fumes, salty atmospheres, water intrusion, and damage caused by lightning.

1.5.4 All cables must run through appropriate conduits (preferably shielded, which shall be provided by the Successful Bidder).

**1.6 Electric power system protection requirements**

1.6.1 Grounding resistance shall be less than 2.5 ohms. Given the large dispersion in resistance values of existing grounding connections in the various nodes due to site-specific characteristics, the Bidder shall make the necessary measurements during the site survey to determine such value, and shall quote, as optional, the relevant works required to obtain a value as close as possible to the cited reference (2.5 ohms).

1.6.2 In such cases, the electric power system shall have an electrode grounding system with similar characteristics to the one proposed for the lightning protection system. The system must comply with NEC article 250.

1.6.3 All electrical systems, equipment, and metal devices shall be connected and grounded. Joints and grounding shall comply with NEC article 250.

1.6.4 The installation of the electrical system shall comply with the NEC code and national standards.

1.6.5 All magnetic-thermal connections of the main AC distribution panels shall be identified in accordance with the station electrical diagrams.

1.6.6 The colour code used for AC circuits shall be consistent with the one indicated in the NEC code (article 200). The wiring shall not have cable splices.

1.6.7 AC circuit cables and protectors shall be sized in accordance with NEC articles 220 through 222, and 310.

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| 1.6.8 The following protection shall be provided:<br>a) Surge arresters.<br>b) General switch for power input.<br>c) Surge protection using magnetic-thermal differentials.<br>1.6.9 The protection system shall be mounted on metal panels. Metal panels and protection devices shall be identified and labelled.<br>1.6.10 Surge arresters shall be primary protectors equipped with correct operation indicators. Surge arresters shall include filters and semiconductor oxide varistors. Protection shall be provided for AC lines.<br>**1.7 Communication equipment protection requirements**<br>1.7.1 If so required by communication system manufacturers, an independent electrode grounding system, similar to the one described for the lightning protection system, should be provided, with a grounding resistance of less than 2.5 ohms.<br>1.7.2 The grounding resistance restrictions indicated in the previous chapter are valid, and thus the Bidder shall quote this facility as optional.<br>1.7.3 Communication cable shielding shall be grounded.<br>1.7.4 Communication equipment shall be grounded directly to a system exclusively dedicated for that purpose.<br>1.7.5 The communication system grounding requirement is in addition to NEC protection standards.<br>1.7.6 The grounding for power and communications systems must be equipotential.<br>1.7.7 Insulated braided tapes shall be used for grounding joints. The current capacity of these tapes shall be at least that of an AWG-6 copper conductor.<br>1.7.8 The communications grounding installation shall conform to the EIA/TIA-607 standard, NEC articles 645 and 800, and the recommended practices contained in the Telecommunications Distribution Methods Manual. | |

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| 1.7.9 Protection shall be provided to all internal communication lines (audio and data) by using two-phase protectors (gas surge arrester, fuse, and diode clamping). Lines exposed to lightning shall use fuses and three-phase protectors (gas surge arrester, MOV, and semiconductor).<br><br>1.7.10 Protection shall also be provided using radiofrequency line surge arresters.<br><br>1.7.11 Audio, data, and radiofrequency line protectors shall not degrade the electrical characteristics of the medium nor affect the signals they convey. Protectors shall comply with UL497, UL497A, and UL497B standards, as applicable.<br><br>**1.8 Protection against atmospheric discharges**<br><br>1.8.1 If necessary, protection shall be provided to the communication room, the VSAT antenna installation, and the VSAT cables.<br><br>1.8.2 The protection system shall conform to NFPA-780 and EIA/TIA-607 standards. Aerial terminals, triaxial down-conductors or bare copper wire mounted on insulators, potential equalisation conductors, and terminals buried around the building shall be used to capture, divert, and dissipate direct lightning discharges. Non-polluting and highly efficient ionising aerial terminals shall be used to anticipate lightning capture.<br><br>1.8.3 Triaxial down-conductors shall be no less than 24 mm, and 99% purity electrolytic bare copper wire shall have 19 threads and no less than AWG-1/0. The indicated gauges may be higher if so recommended by the standards.<br><br>1.8.4 If required, borehole design and construction shall take into account the following:<br><br>a) The natural electrical resistivity and elevation of the ground with respect to sea level;<br><br>b) The use of less resistance layers and of electrodes with the same length as the usable layers;<br><br>c) The replacement of the soil in the borehole with farm soil and the use of electrolytic chemical treatment to reduce soil acidity and protect the electrodes;<br><br>d) The interconnection of boreholes or the use of 50 mm x 0.5 mm copper tape radials buried at a depth of 60 cm to achieve the desired grounding resistance; | |

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e) The use of electrodes in the form of ¾ x 2.40 m electrolytic copper rods and AWG-2 bare copper coiled wire;

f) The radius of the borehole shall not be less than 0.5 m, with the depth required to house the electrodes;

g) If several interconnected boreholes are used, these must have at least a 6-m spacing. The interconnection shall be made using AWG-6 copper wire buried 60 cm deep; and

h) Connections to the electrodes shall be welded using the CADWELD process.

1.8.5 The grounding of the protection system shall be separate from that of the communication and electric power system; however, they must be interconnected. If the local standard does not allow direct connection of grounding systems, then clamps shall be used to reduce differences in potential between grounding systems.

1.8.6 Communication conductors shall not run parallel to the cable of the protection system, and there must be a distance of more than 2 metres between them.

**1.9 Mechanical and electrical requirements**

1.9.1 Both equipment and equipment cables shall be protected against sabotage. The Bidder shall minimise access to equipment and/or cables so as to maximise protection. The installation shall permit easy access by authorised personnel.

1.9.2 All metal, synthetic, or composite surfaces of the different parts of the panels and cabinets shall be properly cleaned, treated, and prepared before applying any paint. The paint to be used shall be of high quality. The colour of the panels and cabinets shall be in harmony with the existing ones where the equipment will be installed.

1.9.3 Details of finishing methods, materials, and colours used shall be supplied along with the Bidder's documentation.

**1.10 Equipment assembly and installation**

1.10.1 To meet operational requirements, the Successful Bidder shall demonstrate that the parts and sub-assemblies can be quickly removed without adversely affecting availability. To facilitate maintenance and replacement of parts, whenever possible, the use of the lower sections of the cabinets shall be avoided.

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| 1.10.2 In order to facilitate prompt maintenance operations, locking devices shall not be used for panels or doors. The Successful Bidder shall preferably choose doors with magnetic locks. | |
| 1.10.3 All units, cards, assemblies, and sub-assemblies shall be mounted in such way that they may be replaced easily and with minimum downtime. | |
| 1.10.4 All mechanical parts of the assemblies shall be clean and duly treated. | |
| 1.10.5 The devices used for protecting against overloads and surges caused by atmospheric phenomena shall be duly secured. | |
| **1.11 Wiring** | |
| 1.11.1 The Successful Bidder shall try to standardise the type and length of cables in the installation. | |
| 1.11.2 Cables shall be laid, depending on the location, on trays, raised floors, suspended ceilings or in pipes. | |
| 1.11.3 Cables shall be laid next to each other, grouped by function, and tied at regular intervals along the way. | |
| 1.11.4 To prevent induction, low-signal cables shall be at a distance of at least 0.25 m from power cables and shall cross at 90-degree angles. | |
| **1.12 Interconnection** | |
| 1.12.1 The Bidder shall interconnect the equipment of the two backbones (satellite and ground MPLS) in such way that in case of failure in the primary medium (satellite), it shall immediately and automatically switch to the ground MPLS backbone, respecting network convergence times. | |
| 1.12.2 Furthermore, the Bidder shall be responsible for interconnecting the proposed equipment to the required existing and external systems, including the supply and installation of any wiring and/or infrastructure. | |
| 1.12.3 All systems proposed by the Bidder shall fall within the framework of existing regulations of accepted international standards. | |

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| 1.12.4 The proposed system shall process and interconnect in accordance with ICAO latest specifications. The exact interface requirements will be confirmed during the site survey.\ | |
| **1.13 Bidder's responsibilities** | |
| 1.13.1 The Bidder shall assume full responsibility for the following issues:<br>a) Project proposal, organisation and distribution of all works.<br>b) Damages caused to the facilities by the Successful Bidder and/or its sub-contractors due to carelessness while performing their work or other actions attributable to their personnel.<br>c) Ensuring that there is no equipment, materials, tools, and additional material left in circulation areas.<br>d) Any deviation from the specifications must be corrected at its own expense.<br>e) Training its personnel and providing them with all necessary elements in order to prevent work-related accidents. | |
| **1.14 Mandatory site survey** | |
| 1.14.1 During the tender stage, the Bidder shall visit all installation sites, at its own expense, to determine and assess the scope of the work to be performed, and shall include a detailed cost proposal. As the site visit is mandatory, proof of site visit will be requested and should be provided within the technical documentation. | |
| 1.14.2 During the site survey, the Bidder shall determine the appropriate location of all systems and structures involved, and identify any problems with the operation of existing systems. | |
| 1.14.3 Furthermore, the Bidder shall study the possibility of reusing the existing resources of the current satellite network (REDDIG), such as the ODUs (Radio frequency transceiver sub-system) and the antenna. | |
| 1.14.4 Based on these visits, the Bidder shall submit its proposal, the preliminary drawings of all civil works, including material specifications and quantities, details of the work, etc., and the associated costs required for completing the project. | |
| 1.14.5 The design shall take into account all local limitations and peculiarities of each site. Under no circumstance should the lack of knowledge of local conditions release the Successful Bidder from complying with the contract. | |

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| **2. REQUIREMENTS APPLICABLE TO SATELLITE BACKBONE EQUIPMENT**<br><br>**2.1 Functional requirements**<br><br>2.1.1 The electronic equipment must be state-of-the-art.<br><br>2.1.2 The equipment shall be built using sub-assembled units, which must be quickly and easily removable by one person. Modular plug-in construction is required for quick service recovery. The number of fixed individual components of cabinet equipment shall be the minimum in order to reduce the need for part replacement in the field.<br><br>2.1.3 The Bidder, as part of its proposal, shall provide the detailed technical specifications for the proposed equipment, materials, and accessories, demonstrating their integration.<br><br>2.1.4 The Bidder shall provide a list of parts that are unique to the system and which, in case of failure, are critical and cause the suspension of the service.<br><br>2.1.5 The useful life of the equipment is expected to be at least seven (7) years. Therefore, the degree to which current technology shall be used throughout the life of the equipment and auxiliary systems will be especially taken into account in the evaluation of the bids.<br><br>2.1.6 The Bidder is required to provide figures for MTBF, MTTR, and MTBCF and availability of all the proposed equipment and the whole system, indicating the calculation method used. The Bidder shall provide the figures for MTBF, MTTR, and MTBCF at other sites with a similar type of equipment installed, for verification by ICAO.<br><br>2.1.7 The Bidder shall demonstrate that the availability of the entire systems (including satellite backbone and terrestrial backbone) is minimum 99.98%. The Bidder shall include within its proposal the appropriate documentation to ensure such minimum level of availability.<br><br>**2.2 Construction**<br><br>2.2.1 The mounting of all components and sub-assemblies must be sufficiently robust to minimise the need for dismounting and packaging them separately for its transportation.<br><br>2.2.2 All equipment shall have a fully solid state design, with all switching functions based on electronic mediums. | |

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| 2.2.3 The equipment shall be capable of self-diagnosis to permit the exchange at module level with minimum use of testing equipment. | |
| 2.2.4 The equipment shall be offered for installation in standard 19" cabinets, except for the UPS. The hardware required to install the equipment inside the racks shall be provided. | |
| 2.2.5 Printed circuit cards and modules shall be assembled for easy removal using plug-in and plug-out procedures and shall be protected against damage due to accidental connection to other identical connectors. | |
| 2.2.6 The number of different types of connectors shall be kept to a minimum. | |
| 2.2.7 In critical circuits, highly stable components shall be used. | |
| 2.2.8 All encapsulated and sealed components (e.g., transformers) shall be firmly positioned in the mounting casings. | |
| 2.2.9 All components and test points shall be clearly identified on cards and modules. Any component subject to damage by electrostatic induction shall be clearly identified. | |
| 2.2.10 Protection shall be provided against component failure due to inadvertent mismatches, incorrect connections, open circuits, and short-circuits. | |
| 2.2.11 Where components are of external manufacture or unusual design, the Bidder shall clearly indicate the name of the manufacturer and must guarantee the availability of continuous supply or replacement of a component for at least seven (7) years of the useful life of the equipment. | |
| 2.2.12 Equipment design and construction shall provide adequate safety for the personnel and the equipment itself during installation, operation, maintenance, and repair. All exposed voltages over 50V shall be covered to prevent accidental contact with maintenance staff. | |
| 2.2.13 All panels and gauges shall be mounted in such a way that they can be read easily and accurately by an operator standing at the associated controls. | |

| SECTION B – GENERAL REQUIREMENTS | |
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| 2.2.14 The number of controls used in the equipment shall be the minimum necessary to ensure satisfactory operation. All control variables shall be equipped with appropriate locking devices or safe access codes to prevent unintended settings. All groove and tongue pairs shall be unequivocally polarised or of such a design to prevent incorrect coupling. | |
| 2.2.15 Cables shall be clearly identified in a prominent point and individually labelled. | |
| 2.2.16 The structural strength and rigidity of equipment units and cabinets shall be such that their loading, shipping, unloading, and placing in the installation site do not result in such a strain that affects cabinet appearance, or interferes with maintenance facilities, the removal of units, ventilation, and the operation of access ports. | |
| 2.2.17 To facilitate installation at the designated sites, the Successful Bidder shall take into account access considerations (doors, windows), in order to determine the maximum size of the equipment in case they have to be dismantled. | |
| 2.2.18 A modular concept shall be used as much as possible to facilitate troubleshooting and fast recovery. Extension plates or systems must be provided to facilitate testing during maintenance procedures. | |
| 2.2.19 Any measurement or monitoring unit for equipment control shall be built-in into such equipment. | |
| **2.3 Software** | |
| 2.3.1 The Bidder shall provide a complete software package (including diagnostics and software licences in equal number as the REDDIG II nodes), which must be free from all known error. Tested off-the-shelf programmes and packages shall be used inasmuch as possible. Software licences must be specified in the proposal, indicating their price and duration. | |
| 2.3.2 Programmes must be designed in structured language and based on open architecture principles. The Bidder shall specify the language(s) and versions used, including all operating systems, and all database management software, and programme development language. | |
| 2.3.3 A structured or object-oriented programming approach should be used to produce secure and stable software that can be easily changed and expanded. All individual programmes used for implementing | |

| SECTION B – GENERAL REQUIREMENTS | |
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| functions shall be modular.<br>**2.4 Hardware**<br><br>2.4.1 It is highly desirable for hardware to simplify logistics and reduce training costs during the equipment life cycle. The same applies to functionalities and auxiliary processors, such as hard drives, CD/DVDs, memory, video cards, etc. Hardware shall have a high level of availability.<br><br>2.4.2 Systems and equipment shall be capable of starting automatically when turned on or upon failure recovery. Cold and hot starting shall be possible. Cold starting shall consist of a start using default system parameters, with all settings and active files duly cleaned. Hot starting shall consist of starting the system using the last parameters used prior to the incident and the active files, with the exception of data from obsolete files, such as track files.<br><br>2.4.3 The operating environment shall have a menu that allows operators to modify different parameters such as brightness, colour, etc.<br><br>2.4.4 Any human-machine interface shall be graphical, user-friendly, and use windows; information shall be displayed in different colours for easy interpretation.<br><br>**2.5 Quality of parts and components**<br><br>2.5.1 Components shall be of superior quality and must operate below their nominal characteristics to increase reliability.<br><br>2.5.2 Components shall be selected to ensure an MTBF that is suited to the environmental conditions of the site of operations.<br><br>2.5.3 Cables shall have a copper conductor and fire retardant insulation.<br><br>**2.6 Electromagnetic compatibility/ grounding**<br><br>2.6.1 The equipment shall operate in the intended operational electromagnetic environment without suffering or causing unacceptable performance degradation due by electromagnetic emissions.<br><br>2.6.2 The equipment shall be grounded in order to minimise radiated or conducted emissions, minimising the risk of electrical shock to the personnel. | |

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| 2.6.3 All components shall be protected against overstress (lightning, power surges, electrostatic discharges, overvoltage and power drops, etc.). The cables supplied with the equipment must be properly shielded. | |
| 2.6.4 Electromagnetic radiation levels must meet personnel safety standards. The Bidder shall specify the standards used to meet this requirement. | |
| **2.7 Maintenance design** | |
| 2.7.1 The proposed equipment must have hardware maintenance facilities for reducing repair times, enabling technical personnel to quickly diagnose a failure, identify the failed unit, and quickly replace it in order to meet availability requirements. A minimum level of preventive maintenance is a fundamental design requirement. | |
| 2.7.2 Maintenance design facilities shall include online and offline diagnosis, start-up diagnosis, test points, self-diagnosis (built-in test equipment - BITE), and fault isolation test (FIT). Any equipment consisting of a computer, a processor, or CPU shall be equipped with diagnosis programmes as part of the software delivered. | |
| 2.7.3 The system shall be equipped with manual auto testing to ensure extensive monitoring of system performance during maintenance and troubleshooting. Auto tests shall be capable of identifying equipment status up to the module exchange level. | |
| 2.7.4 The maintenance concepts applicable to the proposed equipment shall be indicated in the Bidder's documentation. | |
| **2.8 Maintenance support services** | |
| 2.8.1 The Bidder shall provide all the details and information concerning support services. | |
| 2.8.2 The Bidder shall describe in detail the service support policy and procedures, in order for the customer to obtain support services during and after the warranty period. | |
| 2.8.3 Bidders shall indicate in their proposal if they have engineers in the region and, if so, their location and the location of their technical support offices, the measuring equipment they would have available to provide warranty and post-sale services, plus a list of their technical staff, indicating their qualifications and curriculum vitae. | |

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| 2.8.4 The Bidder shall indicate the maximum service response time (SRT) and the maximum turnaround time (TAT) for each of the following services provided during and after the warranty period:<br><br>a) Supply of new modules or sub-assemblies.<br><br>b) Supply of parts or components.<br><br>c) Repair of a defective module.<br><br>d) Repair of a defective sub-assembly.<br><br>e) Request for technical assistance and/or support from the factory for the customer site via phone or the Internet.<br><br>f) Request for technical assistance and/or support from the factory for the customer site so as to provide support services for technical (engineering and/or technical) personnel.<br><br>g) Request modifications to the hardware or software.<br><br>**2.9 Local representation**<br><br>2.9.1 It is recommended that, to the extent possible, equipment, computers, main components, and peripherals supplied, or the system as a whole, have a representative in each AAA.<br><br>2.9.2 The Bidder shall provide all information regarding its representatives, providing the following minimum information:<br><br>a) Name, address, phone, etc.<br><br>b) Type of service offered: repair/replacement of modules or sub-assemblies, maintenance service, etc.<br><br>c) Qualifications and experience of the representatives.<br><br>2.9.3 The Successful Bidder shall ensure local representation, at least during the period of the contract under guarantee.<br><br>**2.10 Technological update**<br><br>2.10.1 The Bidder shall agree that the latest versions of the software, hardware, and associated documentation shall be delivered at no additional cost if new technologies or developments are introduced between the signing of the contract and the time of delivery and/or installation of the equipment. ICAO's approval is required before | |

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| any substitution occurs.<br>2.10.2 The Bidder shall undertake to deliver the documentation corresponding to any updates on the equipment during the useful life of the equipment.<br><br>**2.11 Support during the life cycle**<br><br>2.11.1 The Successful Bidder shall provide support throughout the useful life cycle of the equipment for a minimum of seven (7) years, as of the expiration of the warranty period. This support shall ensure that the specifications and test results are maintained throughout the useful life of the system. The support, if requested by ICAO, with costs borne by ICAO, shall consist of the following:<br><br>a) The Successful Bidder shall provide maintenance and repair for all replaceable units requiring specialised repair.<br>b) On-site support, when needed, to maintenance personnel for the operation, maintenance, and troubleshooting of systems.<br>c) The Successful Bidder shall provide documentation for the technical updates of the equipment during its useful life cycle.<br>d) Calibration and repair of specialised testing equipment.<br>e) Training<br>f) Provision of software updates.<br><br>**2.12 Packaging**<br><br>2.12.1 The goods to be delivered must be new, original, and meet the specifications and tolerances indicated herein.<br><br>2.12.2 The delivered goods must be packed and sealed, and clearly marked with sufficient detail for their identification. The packaging shall provide guaranteed protection for the equipment against adverse weather conditions and other factors that could affect the quality of the equipment even during prolonged storage. Regardless of the shipping method, all facilities for proper package handling shall be provided.<br><br>2.12.3 The packaging to be used for transporting the equipment and/or material from the factory to the installation sites must follow standard factory practices for long-haul transportation.<br><br>2.12.4 Prior to packaging, the goods shall be subject to the required Factory Acceptance Tests (FAT) to verify the quality and compliance with technical requirements.<br><br>2.12.5 The Successful Bidder shall be responsible for the storage of all equipment before its installation. | |

## SECTION C – TECHNICAL REQUIREMENTS

### 1. INTRODUCTION

1.1 The REDDIG II (regional digital network) emerged from the need to maintain the communications and air navigation services currently provided by the REDDIG between the different air traffic units in the Region, and to implement the Aeronautical Telecommunications Network (ATN) backbone.

1.2 The International Civil Aviation Organization, as contractor on behalf of Member States, and through Technical Cooperation Project RLA03/901, is the body responsible for the coordination, awarding and management of the cited Project for the modernisation of the REDDIG.

1.3 The countries and nodes that participate in this bidding process, with their basic geographic coordinates, are listed in Table 1.

| Country | Node | Call Sign | Latitude | Longitude |
|---|---|---|---|---|
| Argentina | Ezeiza | SAEZ | 34° 49’ 25” S | 58° 31’ 43” W |
| Bolivia | La Paz | SLLP | 16° 30’ 29” S | 68° 11’ 24” W |
| Brazil | Manaus | SBMN | 03° 02’ 19” S | 60° 02’ 59” W |
| | Recife | SBRE | 08° 07’ 36” S | 34° 55’ 23” W |
| | Curitiba | SBCT | 25° 31’ 43” S | 49° 10’ 33” W |
| Chile | Santiago | SCEL | 33° 23’ 26” S | 70° 47’ 09” W |
| Colombia | Bogotá | SKED | 04° 42’ 05” N | 74° 08’ 48” W |
| Ecuador | Guayaquil | SEGU | 02° 09’ 29” S | 79° 53’ 02” W |
| Guyana | Georgetown | SYGC | 06° 29’ 56” N | 58° 15’ 16” W |
| French Guiana | Cayenne | SOCA | 04° 49’ 11” N | 52° 21’ 38” W |
| Paraguay | Asunción | SGAS | 25° 14’ 24” S | 57° 31’ 09” W |
| Peru | Lima | SPIM | 12° 01’ 19” S | 77° 06’ 52” W |
| Suriname | Paramaribo | SMPM | 05° 27’ 10” N | 55° 11’ 16” W |
| Trinidad and Tobago | Piarco | TTZP | 10° 37’ 48” N | 61° 31’ 12” W |
| Uruguay | Montevideo | SUMU | 34° 50’ 15” S | 56° 01’ 49” W |
| Venezuela | Maiquetía | SVMI | 10° 36’ 12” N | 66° 59’ 26” W |

**Table 1: Location of the REDDIG Nodes**

## SECTION C – TECHNICAL REQUIREMENTS

### 2. CURRENT INFRASTRUCTURE

### 2.1 Basic topology

2.1.1 The basic topology of the current REDDIG, with its sixteen nodes, is illustrated in Figure 1.


**Figure 1: Current REDDIG topology**

2.1.2 In addition to that shown in Figure 1, the REDDIG is interconnected with the MEVA II network, which serves the Central American countries, the Caribbean and the United States. For that interconnection, the REDDIG uses the Bogotá (Colombia) and Maiquetía (Venezuela) nodes, as described in Figure 2. In addition, a REDDIG MODEM was installed in the Honduras (Tegucigalpa) MEVA II node, for REDDIG interconnection with MEVA II. This should be kept, upon implementation of REDDIG II.

## SECTION C – TECHNICAL REQUIREMENTS

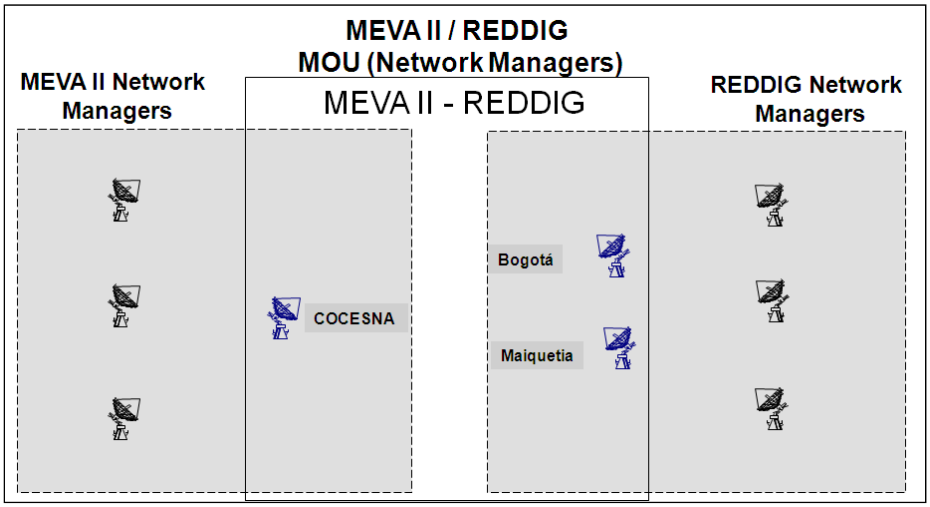


**Figure 2. MEVA II – REDDIG Interconnection**

### 2.2 Basic characteristics

2.2.1 The REDDIG is a meshed network that applies VSAT (*Very Small Aperture Terminal*) technology with 3.7m antennas in the C band (4-6 GHz), using the INTELSAT IS-14 satellite that is located 315° E. Currently, the leased capacity to meet the needs of REDDIG applications is 4.4 MHz.

2.2.2 The REDDIG has a total of 1.328 Kbps for the traffic between all the terminals in the network, which is equivalent to 16-Kbits/s 83 bursts.

2.2.3 The current satellite provider is INTELSAT, and the International Civil Aviation Organization (ICAO), United Nations (UN) Agency, is responsible for reserving and paying for the required bandwidth.

2.2.4 The REDDIG network uses the C band (4-6 GHz), as required by weather conditions in the areas where some of its nodes are located.

2.2.5 The main equipment (indoor and outdoor), as well as the software used, is described in **Appendix A**, while the main voice and data services are described in Appendix B.

2.2.6 The network also supports local and RC&M (*Remote Control & Monitoring*) for efficient resource management. There are two network control centres (NCC), the main one located in Manaus (Brazil) and the alternate in Ezeiza (Argentina).

## SECTION C – TECHNICAL REQUIREMENTS

2.2.7 The interconnection between the MEVA II and REDDIG networks maintains the basic individual features of the two networks in terms of management and control. However, it adds a MEVA II modem in the REDDIG nodes of Bogotá (Colombia) and Maiquetía (Venezuela), and a REDDIG modem in the MEVA II node of COCESNA (Honduras).

2.2.8 It is noted that all the requirements of the ports required in the routing system, which are to be supplied by the Successful Bidder, have been added in **Appendix B**. Appendix B also contains the operational requirements related to such interconnection.

### 3. FUTURE NETWORK ARCHITECTURE

### 3.1 Basic topology

3.1.1 Figure 3 illustrates the basic topology required for REDDIG II.

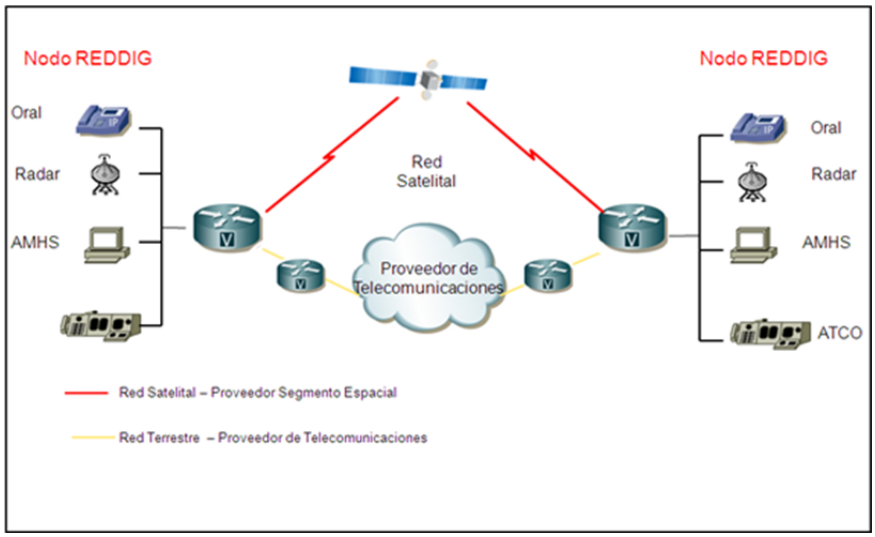


**Figure 3: Basic REDDIG II topology**

### 3.2 Basic design considerations

3.2.1 It shall consist of **two backbones**: a satellite backbone and a ground MPLS backbone, as shown in Figure 3. Their integration shall be the responsibility of the Successful Bidder.

## SECTION C – TECHNICAL REQUIREMENTS

3.2.2 The network shall be fully meshed, its topology determined by the need for links between its nodes. All REDDIG II communication requirements are described in *Appendices B and C* to this document.

3.2.3 It shall be implemented by a **single company**, which shall be responsible for the supply, installation and start-up and operation of all the equipment of the satellite *backbone*, as well as for the initial implementation of services related to the ground MPLS backbone of the REDDIG II. A **summary of the supply** appears in *Appendix D* to this Section.

3.2.4 The design of the network must be such as to enable communication requirements between nodes to increase, and new nodes to be created, without changing significantly the philosophy of the digital network subject of this tender.

3.2.5 *Current services cannot be interrupted. Accordingly, Bidders shall describe in detail how the proposed transition will take place.*

3.2.6 The minimum communication requirements between nodes are described in detail in Appendices B and C to this document, for the satellite backbone and for the ground backbone respectively. In no case shall the Bidders reduce the requirements listed in the aforementioned Appendices. Bids that do not meet the minimum requirements established in these appendices will not be considered.

**3.2.7 Taking into account that the capacity of the existing REDDIG is 1,328 Kbps (amounting to a space segment utilisation of 4.4 MHz), the Bidders shall calculate the associated space segment for the current rate in such a way that ICAO may estimate future recurrent monthly costs for the implementation of the REDDIG II satellite backbone.**

3.2.8 The equipment to be installed and the parts that the Bidders consider appropriate for the ground and satellite networks will depend on the technical solution proposed by the Bidders based on the requirements specified in this document.

3.2.9 *The Bidders, based on their own conclusions following the site survey, may reuse part of the material existing in the nodes (e.g., antenna, ODU, etc.).*

## SECTION C – TECHNICAL REQUIREMENTS

### 4. SATELLITE BACKBONE REQUIREMENTS

### 4.1 Introduction

4.1.1 The REDDIG II satellite backbone will be a private digital communications network with an estimated useful life of at least seven (7) years, open architecture and start-of-the-art technology.

### 4.2 Basic architecture requirements

(a) It shall be implemented with a fully meshed, flexible and scalable topology to facilitate changes and network growth.
(b) High availability, with:
  (i) Distributed intelligence in its nodes, with no common point of failure.
  (ii) Traffic prioritisation.
  (iii) Dynamic management based on bandwidth demand.
  (iv) Automatic alternate routing of traffic in case of failure.
  (v) Continuous and seamless utilisation and unattended operation.
(c) It shall have a distributed configuration, with a multi-service (voice and data)/multi-protocol, IP-based platform in each node, with dynamic bandwidth management that provides access and routing of packages for statistical networks in layer 3 of the OSI model.
(d) It shall ensure that, for all voice communications provided, there will be no end-to-end delays of more than 400 milliseconds.

### 4.3 Basic composition

a) Routing system
b) VSAT system
  – Dish antenna
  – Radio frequency transceiver sub-system (ODU)
  – Modulation and demodulation sub-system (IDU)
c) Network management system

### 4.4 Routing system

4.4.1 The routers that make up the routing system (SR) of the REDDIG satellite backbone shall be supplied in a redundant configuration (1+1) with the following characteristics:

| SECTION C – TECHNICAL REQUIREMENTS | |
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| 4.4.2 They shall have:<br>a) The minimum amount of memory required for performing all the functions required in this specification, in accordance with the manufacturer's recommendations.<br>b) SNMP and MIB-II management protocols, implemented in accordance with RFC 1157 and RFC 1213, respectively.<br>c) *Gateway* functionality for voice over IP with all the required functionalities.<br>d) The necessary characteristics for the implementation of the RTP/RTCP and RTP "header compression" protocols, in accordance with en RFC 2508.<br><br>4.4.3 They shall enable:<br><br>a) The configuration of traffic prioritisation methods by type of protocol and by TCP/IP protocol stack service.<br>b) The implementation of the following filtering functions: selection of services, TCP/IP stack commands, and creation of address filtering tables.<br>c) The use of a protocol that permits the establishment of service classes, with band reservation, with assurance of critical application prioritisation, in accordance with defined IP standards (RFCs).<br>d) The interoperability, including for VoIP, with Cisco routers of the most varied types that already exist in the REDDIG nodes.<br><br>4.4.4 Remote access functionality, enabling at least five (5) simultaneous connections through the use of codes of different levels, and enabling restrictions to the configuration of equipment and commands that disrupt their operation.<br><br>4.4.5 Implement routing protocols:<br><br>a) RIPv1 (RFC 1058).<br>b) RIPv2 (RFCs 2453, 1723 and 1724).<br>c) EIGRP.<br>d) OSPF Version 2, in accordance with the following RFCs (RFC 2328, RFC 1793, RFC 1587 and RFC 2370).<br>e) BGPv4, in accordance with RFCs 4271, 4272, 4360, 4374, 4451, 4456, 1966, 1997, 2796, 2439, 2858, 2918.<br><br>4.4.6 Each router shall be physically capable of implementing all the configurations of the initial applications, as described in Appendix B.<br><br>4.4.7 Each router shall be physically capable of receiving interfaces for future expansions. | |

## SECTION C – TECHNICAL REQUIREMENTS

4.4.8 All documents may be subject to updates and replacements, and therefore the Successful Bidder shall submit updated documentation when signing the contract.

4.4.9 The routing system shall:

a) Be interconnected with the routing system of the ground service provider, in accordance with the description in Figure 3.
b) Be capable of managing the alternate routing for the ground MPLS backbone in case of failure.
c) Be capable of header compression, TCP acceleration, and load balancing techniques.
d) Have all the ports required to meet current and future requirements listed in Appendix B.
e) Establish permanent and switched voice and data communications. Switched communications will be established upon user request.
f) Establish closed user groups for telephony and data traffic.
g) Include metrics that will permit the automatic establishment of the pathways that provide the least delay in communications within the bandwidth available in the network.

h) Include facilities for the definition of circuits, addressing, transmission rates and traffic prioritisation, applying quality of service (QoS).
i) Establish private IP networks (VPN) and interconnect with public networks.
j) Include the elements required for network synchronisation.
k) Be integrated into the network management system (NMS).

4.4.10 Router management: it is desirable that the Successful Bidder provide the accounts to access the management system, with different privilege levels for accessing, monitoring and changing the configuration of networking devices to be installed.

**4.5 VSAT system**

4.5.1 It is the platform through which the main links between nodes must be established using a satellite repeater.

## SECTION C – TECHNICAL REQUIREMENTS

### 4.6 Requirements

4.6.1 The VSAT system shall comply with the following:

a) HUBLESS network, with no common point of failure. All stations shall be identical, with no specialised stations. Two stations (Manaus and Ezeiza) must be capable of serving as time reference stations for the satellite network.

b) Safe control scheme through pre-established and programmable rotation that defines the master terminal and the backup terminal, with automatic shifting in case of failure of the master station, or self-synchronisation architecture that does not require a master station.

c) Full *mesh* topology: links must be established to meet the network topology and the communication requirements listed in Appendix B.

d) All communications must be established through a single satellite hop.

e) Satellite links will have a BER better than 1 E-7.

f) Operation in the C band. The bid will clearly indicate the satellite and beam chosen, and shall also include coverage maps, PIRE, and G/T and SFD footprints (*preference will be given to the use of Intelsat IS-14*). Likewise, the remaining expected life of the selected satellite shall be indicated.

g) The ground stations of the nodes shall have dish antennas approved by the service provider, of a suitable size, to reduce the cost of the space segment to be leased.

h) Must be IP native, user interfaces must be RJ-45 Ethernet 10/100 BaseT. The system shall route IP packets through the satellite network, and must support sub-network definitions and subnet masks.

i) *Supported protocols*: At least IPv4, IPv6 (must be included in the system evolution roadmap), TCP, UDP, ARP, RARP, ICMP, VoIP DSCP, DNS UDP, HTTP, HTTPS, SSH, IPSec Tunnelling, dynamic OSPF routing and static IP routing. Must support routing and prioritise VoIP SIP and H.323. The Bidder shall list all the protocols supported.

j) *TCP improvements*: The system must have header compression and TCP payload, as well as facilities for optimising TCP performance in high-latency links, such as TCP PeP (*Performance Enhancement Proxy*), protocol spoofing, etc. The Bidder shall list the TCP improvements that can be achieved.

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| k) Quality of *service*: The system must have extensive QoS and traffic formation facilities to support traffic of different characteristics and priorities: VoIP, VoIP signalling, videoconferencing (ViC), fax, critical data (CD) and best effort (BE) data. Such facilities must be, at least, IP ToS and DiffServ QoS. It shall also be possible to define the CIR (committed information rate), the MIR (maximum information rate) the parameters by service, port address and/or origin/destination. Likewise, it shall be possible to assign permanent fixed capacity (*clear channel*). It shall be possible to define at least 4 levels of priority by type of service or by port. It shall compensate for, or mitigate, the effects of delay and delay variations in satellite channels. The bid shall list all QoS facilities and the algorithms available in the system, and indicate how each requirement stated here will be met.<br>l) *Rate of transmission*: Each station shall be capable of operating at a rate of 6 Mbit/s or more, full duplex, at the level of the IP interface.<br>m) Efficient use of the space segment, with dynamic bandwidth assignment. Preference will be given to solutions that optimise the use of the transponder in terms of bandwidth and power.<br>n) Advanced state-of-the-art technical solutions that use the least possible number of transmission carriers and highly efficient error modulation and correction schemes, approved by the service provider, shall be promoted to maximise efficiency in terms of the bit/s/Hz ratio. Such efficiency shall be reflected in the planned network link and traffic budget to be included in the proposal.<br><br>4.6.2 The carriers must use at least:<br><br>(d) *Modulation*: 8PSK.<br>(e) *Coding*: Turbo Coding and/or LDPC, with at least three code ratios. The bid shall list all attainable codes, Eb/N0 threshold values and bit-error rates for each modulation-coding combination.<br>(f) Satellite access technique: preferably MF-TDMA.<br>(g) Monitoring, adjustment and automatic control of station operating parameters (power, frequency, Eb/No reception level, carrier activation and deactivation, etc.).<br>(h) Automatic control for adjusting power and operating frequency in accordance with the transmission plan.<br>(i) Integrated to the network management system (NMS).<br>(j) Automatic reporting of alarms resulting from transmission power loss, frequency shift, degradation of the signal received, loss of synchronism, and other occurrences that affect the normal performance of the system. | |

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(k) The expansion of voice and data services shall not require changes in the VSAT system. These expansions shall be made in the routing system.

### 4.7 VSAT terminal

4.7.1 The VSAT terminal consists of the following main parts:

a) Dish antenna.
b) RF unit(s) (RFU).
c) Indoor mounted unit(s) (modems).
d) *Accessories*.

### 4.8 Dish antenna

a) High efficiency and high gain.
b) Approved by the space segment provider.
c) *Frequency range (Tx. /Rx.): C band*
d) Circular and linear feeder, depending on the satellite and transponder chosen.
e) Capability of switching the type of polarisation in the field.
f) Orthogonal-mode transducer for Tx and Rx separation (30.7 dB).
g) The diameter of the antennas should not exceed 3,7 m.
h) The antenna must have the appropriate mechanisms to enable coarse and fine mechanical azimuth and elevation adjustment.
i) The antenna and its mounting elements must be resistant to corrosion, saline and caustic environments, pollution and ultraviolet radiation.
j) The antenna and its supports and anchors must be capable of withstanding winds of up to 100 Km /h.

### 4.9 RF transceiver subsystem (RFU)

a) Must contain all RF electronics required for transmitting and receiving satellite signals.
b) High reliability and availability.
c) The transmission block must be based on a solid-state amplifier and up-convertor, synthesised frequency.
d) The reception block must consist of a low-noise booster (LNB), synthesised frequency.
e) This unit must be totally redundant.
f) Interface with the NMS for observing and controlling the frequency, power, Eb/No reception level and carrier activation and deactivation.

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g) External mounting in closed casing of easy access. It must be located so as to minimise antenna/feeder/waveguide combination losses.
h) The RFU and its outdoor electrical connections must be weather-proof. It will also be protected against direct atmospheric electrical discharges.

**4.10 Modulation and demodulation subsystem (IDU or modem)**

a) High reliability and availability.
b) This unit must be totally redundant. Redundancy switching shall be done through the NMS system.
c) This unit consists of the modem, the controller and the network interface.
d) Transmission frequency: 140 MHz or L band.
e) Stepped synthesiser.
f) Modem input and output levels, adjustable through the NMS.
g) Programmable transmission speed, minimum range of 512Kbps to 5 Mbps
h) IESS filtering.
i) Interfaces: Ethernet 10/100 Base T, RJ45, RS232, V35, RS530 or V36.
j) Gauges: Eb/No, frequency, power level

**4.11 Monitoring and control system (NMS)**

4.11.1 **Local and network supervision**

4.11.1.1 The REDDIG II has 16 nodes, and each must be provided with a monitoring and control system (NMS). This NMS system must be based on the SNMP protocol to enable control and supervision of all nodes, systems, subsystems and equipment that make up the REDDIG II. This chapter describes the minimum technical and operational requirements of the NMS system.

4.11.1.2 There will be only one REDDIG II administrator. The administration of the REDDIG will be done from the NMS workstation of the Manaus node (Brazil) and its alternate will be Ezeiza (Argentina), respecting the current configuration. The bidders will offer a solution in which the functions of the REDDIG II administrator may be taken over by another NMS workstation of another node. The assignment of the workstation as network administrator shall be based on software-programmable parameters.

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4.11.1.3 The NMS system must be based on a network architecture and support the concurrent operation of the workstations that make it up. The system administrator will have control over all REDDIG II nodes. The REDDIG II administrator will be the only one to assign the domain and functions that can be performed by the workstations that make up the NMS system.

4.11.1.4 Any failure or interruption of the NMS must not affect nor interrupt the normal operation of the REDDIG II.

4.11.2 **Technical and operational requirements of the NMS system**

4.11.2.1 The bidders will include in their bids a clear description of the NMS system that they offer, including details of its architecture and operation. The proposed system shall list, at least, the following:

(a) Equipment and systems.
(b) Interfaces.
(c) Statistics: traffic of information (alarms and tele-commands) between network stations, and on the use of the IP cloud.
(d) Work platform.
(e) Software.
(f) Modular design, graphical interface (GUI):
  (i) Geographical maps showing network nodes.
  (ii) Topological maps of network/sub-networks.
  (iii) Representation of the status of nodes, systems, subsystems and equipment.
  (iv) Equipment composition and configuration graphs.
  (v) Detailed and block connection diagrams.
(g) The graphical interface must provide the operator with:
  (i) Mechanisms for selecting network objects through pointing devices.
  (ii) Commands for displaying and hiding the details of the selected object (zooming).
  (iii) Commands for displaying indicators and for operating the equipment controls.
(h) Mechanisms of protection against malfunction and unauthorised access.
(i) No events, set of events or solutions occurring on the communication links/circuits that are used for network management shall result in NMS system failure.
(j) Capability of automatically reconfiguring, in case of failure, the route segments that have an alternate route.
(k) Native commands and facilities of the equipment.
(l) It should be possible to execute all the native commands and facilities of the equipment through the NMS.
(m) High-security backup access through the PSTN.

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| (n) Parameters for defining NMS system users, workstations, passwords, domains and functions permitted to users.<br>(o) Capability of defining an alternate administrator in case of failure of the main administrator.<br><br>**4.12 NMS system equipment**<br><br>4.12.1 The NMS system will have at least the following elements in each node:<br><br>4.12.1.1 Workstation:<br><br>a) 64 bit 6-core processor, 2 GHz or greater.<br>b) RAM memory of no less than 2 GB.<br>c) Network interface: Giga bit Ethernet, USB.<br>d) Two hard disks, each no less than 200 GB.<br>e) Screen: 27” HDMI LED, LCD backlight; resolution: 1920 x 1080; brightness: at least 250 cd/m2.<br><br>4.12.1.2 Printer:<br><br>a) Monochromatic, laser type.<br>b) Resolution: 1200 dpi or better.<br>c) Paper formats: A4, letter, and others.<br>d) Printing speed: at least 30 PPM.<br>e) Ports: USB, Ethernet 10/100 Base-T.<br><br>4.12.2 For network control stations (NCC), whether primary or secondary, redundant elements (hardware y software) shall be provided with identical characteristics to those described above.<br><br>4.12.3 **System functions**<br><br>4.12.3.1 The functions available for the various users of the NMS system shall be at least the following:<br><br>a) Create and modify the database.<br>b) Configure and programme.<br>c) Manage network stations independently or by domain<br>d) Facilitate access for system maintenance.<br>e) Issue reports and statistics automatically and upon user request.<br>f) Supervise and monitor.<br>g) Diagnose failures.<br>h) Alarm management. | |

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| 4.12.4 **Database**<br><br>4.12.4.1 The database management software shall be distributed and object–oriented. It shall have LOG files.<br><br>4.12.4.2 The database shall be duplicated. The operational DBS and its updated image shall reside in physically independent hard disk units.<br><br>4.12.4.3 The software must be capable of generating an operational DBS image on any hard disk unit, after which the disks must operate in dual mode. This facility must be initiated using a command generated by the system administrator.<br><br>4.12.4.4 The database will have a read-only inviolable security record for database alteration actions that affect network operation, valid for up to 60 days.<br><br>4.12.4.5 The system will be capable of reading the information residing in the network/sub-network equipment and subsystems, and comparing this information with that available in the database, and will also permit the updating of the DBS with this type of information.<br><br>4.12.5 **Reports**<br><br>4.12.5.1 The system shall have a report generator that permits adequate storage, display and printing of graphical reports from the system database (DBS).<br><br>4.12.5.2 The system will have the necessary tools to enable users to create and modify the format and content of outgoing reports.<br><br>4.12.5.3 Reports may be initiated automatically (alarms, routine reports), and also upon user request.<br><br>4.12.5.4 The system will include in its menu of basic outgoing reports (graphs and tables) at least the following types:<br><br>a) Network/sub-network topology.<br>b) Node configuration.<br>c) Equipment configuration.<br>d) Record of database modifications.<br>e) Operation and traffic statistics.<br>f) Record of alarms.<br>g) Active alarms.<br>h) Others. | |

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4.12.6 **Monitoring and supervision**

4.12.6.1 The network management system shall monitor, on an on-going basis, the operation of each node, system, subsystem and network equipment. The proposed supervision shall take into account redundancy.

4.12.7 **Alarms**

4.12.7.1 The system shall be prepared for processing the alarms generated in the network under a graphical and windows environment, and shall be capable of performing the following functions:

a) The occurrence of any alarm on any equipment or node of the system will be reported to the administrator immediately and in accordance with a pre-established order of priority.
b) Alarms shall be classified by level.
c) Valid alarms should automatically trigger diagnostic procedures to help locate the failure.
d) Alarms will be recorded on the display, printer and disk (LOGS), and the information will contain at least the following fields:
   (i) Date and time the alarm was set off.
   (ii) Station where the alarm occurred.
   (iii) Identification of the equipment that generated the alarm.
   (iv) Failure code.

4.12.8 **Diagnosis**

4.12.8.1 Diagnostic procedures may be initiated automatically (error or alarm condition on the network) and also upon user request.

4.12.8.2 Diagnostic procedures should be based on intelligent models that permit the isolation of network elements in order to precisely detect and locate the failure, at least up to the equipment and module level.

**4.13 Failure tolerance and recovery**

4.13.1 **General aspects**

4.13.1.1 The REDDIG II satellite backbone architecture and the systems included in the supply must be failure tolerant, and there must be no common element whose failure would cause the interruption of the services provided by the network.

4.13.1.2 System failures can only cause a gradual degradation of the services

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| provided by the REDDIG II.<br><br>4.13.1.3 All systems and equipment supplied for the satellite backbone must have mechanisms for automatic detection of malfunctions, reconfiguration and restart in order to continue providing the intended service with no need for manoeuvring by the operator.<br><br>4.13.1.4 The equipment must be capable of restarting automatically when the following events occur:<br><br>a) Hardware and software failure.<br>b) Start-up (power connection).<br>c) Power restoration after a power supply cut-off.<br>d) Hot swapping of cards.<br>e) Direct action by the operator (*resetting*).<br>f) Under no circumstance, total or partial outages caused by:<br>(i) Automatic recovery from failure.<br>(ii) Automatic start-up upon power restoration.<br>(iii) Power restoration after a failure.<br>(iv) Resetting by the operator.<br><br>4.13.1.5 *Failure tolerant* must be interpreted as a set of similar entities equipped with automatic mechanisms for mutual support in case of failure and/or outage of any of the elements of the set, in order to continue providing their services. The operation of these mutual assistance mechanisms should not disrupt the operation and services being provided.<br><br>4.13.1.6 *Redundant* must be interpreted as the implementation of failure tolerance using identical entities.<br><br>4.13.1.7 *Independent entities* (such as equipment, ports, circuits, etc.) must be interpreted as entities that do not physically depend on each other and that do not have or use a common element (such as the same card, the same control, etc.).<br><br>4.13.1.8 *Redundant equipment* must be interpreted as a physical entity supplied on a common chassis with redundancy in its common parts (power source, control, switching map, transmitter, receiver, etc.), and which allows for the replacement of its common parts without causing service interruptions.<br><br>4.13.1.9 *Simple equipment* must be interpreted as a physical entity supplied on a common chassis, with no redundancy of its common parts (power source, control, switching map, transceiver, etc.). | |

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| 4.13.1.10 The system configuration offered must permit the network management system to periodically test the backup equipment or the duplicated part of the redundant equipment in order to determine its operating status. These tests must not interrupt the service. If possible, tests should be conducted in a way as similar as possible to the way in which the equipment operates, preferably sending traffic over the network. | |
| 4.13.1.11 The routing system must be failure tolerant, by means of two (2) identical and independent equipment units. | |
| 4.13.1.12 The bid must consider at least a suitable distribution of the circuits of the contracting party in the routing subsystem to minimise service degradation in case of failure. | |
| 4.13.1.13 The circuits of add-ons of the contracting party that contain and/or transport traffic of more than two entities must be connected to the SR through two independent physical ports. The system must be configured in such a way that failure of one port will not result in service degradation. As an alternative, the Bidder may propose the connection to only one port of the redundant system. | |
| 4.13.1.14 The circuits of add-ons that interconnect the supplied items to the SR must do so exactly as set forth in the previous paragraph. | |
| 4.13.2 **VSAT system** | |
| 4.13.2.1 Bids must consider the failure tolerance solution based on a redundant VSAT terminal. | |
| 4.13.2.2 The VSAT terminal consists of the modem subsystem, the RF transceiver subsystem, the antenna, lines, waveguide, and other elements and accessories required for the operation. | |
| 4.13.3 **Redundant VSAT terminal** | |
| 4.13.3.1 Redundancy must be provided to the RF transceiver subsystem. Two sets of identical and independent cables must be used for interconnecting the transceiver subsystem (ODU) with the modem subsystem (IDU). | |
| 4.13.3.2 The bid must consider at least the provision of a failure-tolerant modem sub-system based on two or more duly interconnected and conditioned units. Failure of one unit must not degrade any of the services provided by the REDDIG. | |

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4.13.3.3 In the event the configuration of the modem subsystem requires more than one unit to provide the intended service, the bid must include the supply of backup equipment in addition to that described in the previous paragraph, in a N+M configuration, to ensure the availability requested for REDDIG, without service degradation resulting from the possibility of multiple failure in the modem subsystem.

4.13.4 **Network management system**

4.13.4.1 The network management system must be failure tolerant. In general, the equipment does not need to be redundant, but the requirements set forth in this document must be met.

4.13.4.2 Failure tolerance must be based on recursive delegation of the administrator's functions, in accordance with a pre-established order of priority, to one of the remaining workstations of the network management system.

4.13.5 **Satellite backbone failure tolerance overview**

4.13.5.1 Figure 4 contains a block diagram of a typical satellite backbone node of REDDIG II.

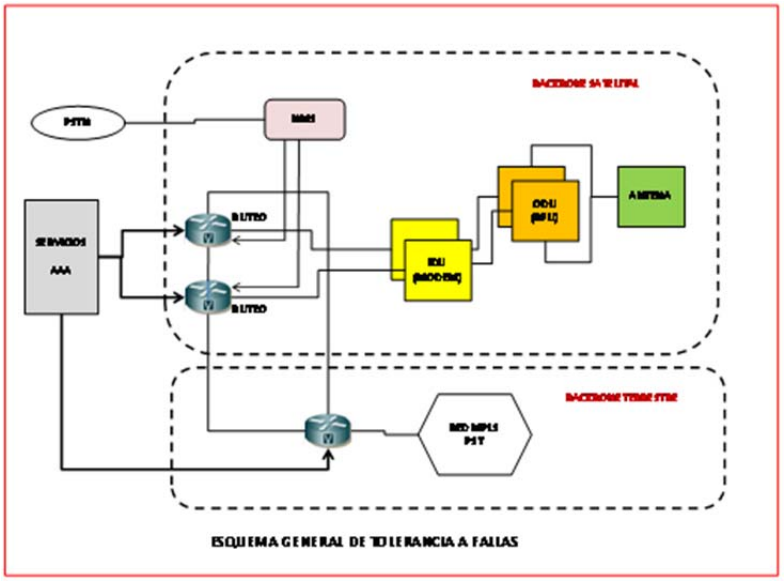


**Figure 4 – Failure tolerance scheme**

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### 5. GROUND BACKBONE REQUIREMENTS

### 5.1 Basic requirements

5.1.1 As stated in Chapter I of this section, the Successful Bidder will be responsible for:

a) The supply of equipment and the implementation of the satellite backbone.
b) Initial contracting, during the first six (6) months of implementation and start-up of REDDIG II, of the ground MPLS backbone, subcontracting the company specialised in the provision of ground communication services (hereinafter PST), so that the time elapsed from start-up of operations of the new network until reaching a mature operation of the network (estimated in 6 months) will be under the responsibility of a single supplier. Accordingly, all the requirements in this chapter will contain the term "bidder" or "Successful Bidder" (as applicable) instead of "PST", although it is clearly understood that the latter will take care of the associated supply and works.

5.1.2 After this period, ICAO will contract directly the services of the PST for a period of four and a half (4 ½) years (see more details in the paragraph entitled "Contracting conditions" in this same chapter). Accordingly, the bid must include the PST bid for this last period, effective for six (6) months.

5.1.3 The ground MPLS backbone shall include the establishment of regional network access circuits to the PST network (PST backbone), as well as the appropriate interfaces required for full integration of the applications of interest of REDDIG II member States, as shown in Appendix C to this section.

5.1.4 Before signing the contract, the Bidder shall specify if the contracts for ducts or infrastructure will be shared with other telecommunication infrastructure providers, indicating the segments and describing how these resources will be supported.

5.1.5 In case of outsourcing, the Bidder shall list these third party PSTs, and assume full responsibility for the operation and availability of such resources, with levels of quality that are consistent with the Service Level Agreement (SLA).

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5.1.6 The Bidder shall present a map of the associated PST backbone, indicating the location of edge routers and where will the points of presence (PP) to be installed in the ground backbone of the REDDIG II will be interconnected.

**5.2 Terminal equipment (TE)**

5.2.1 For the supply of end-to-end communication circuits, the Successful Bidder shall provide and install all TE at each of the sites indicated in **Appendix C**.

5.2.2 The TE will include the routers, modems and other equipment required for the installation of the points of presence (PP) of the ground MPLS backbone, where routers will be supplied with all the functionalities foreseen for the applications defined and described in Appendix C.

5.2.3 The TE shall support all the defined applications, in the numbers specified for immediate implementation of the ground MPLS backbone II, that is, the cited equipment shall have as many ports and/or interfaces as required for all initial applications listed in Appendix C, and shall have the slots to support the installation of future ports and/or interfaces, taking into account the bandwidth up to the possible access limit for the required applications.

5.2.4 The TE shall be interconnected to the routing system of the REDDIG II satellite backbone. To that end, Appendices B and C foresee an Ethernet port in the two routing systems of the cited backbones.

5.2.5 All the equipment to be supplied by the Successful Bidder shall be described in the bid, indicating:

a) Brand
b) Model
c) Processor characteristics
d) Memory (type and capacity)
e) Operating system
f) Function to be performed by the proposed solution in the project
g) Other supplementary information deemed necessary for the proper understanding of the proposal.

5.2.6 Each TE shall:

a) Be sized to support all the applications of each PP, with emphasis on the local voice applications included in this

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document.

b) Be physically capable of implementing all the configurations of the initial applications, in accordance with that described in Appendix C.

c) Be physically capable of receiving interfaces for future expansions.

**5.3 Access network**

5.3.1 Each PP shall be provided with a dedicated digital access exclusively for connecting to an edge router of the Successful Bidder network, with an effective minimum rate equal to the rate requested in **Appendix C**. The tributary of the access circuit of each PP may not be shared with any other customer of the Successful Bidder.

5.3.2 Access circuits shall absorb 100% (one hundred per cent) of the traffic related to the contracted rates, ensuring that packets will not be discarded if within the range covered by the contracted capacity.

5.3.3 The Successful Bidder shall supply all TE and take responsibility for its maintenance to ensure the contracted level of service. The corresponding cost shall be contemplated in the prices listed in the bid.

5.3.4 All TE must be configured in accordance with that specified in Appendix C to this Section.

5.3.5 The Successful Bidder will be responsible for the configuration and management of its TE to ensure the contracted level of service.

**5.4 Technical requirements**

5.4.1 **General characteristics**

5.4.1.1 Communication circuits shall **meet** the standards of the ITU-T and the appropriate regulatory telecommunication institutions of REDDIG II member States.

5.4.1.2 The monthly **availability** of each PP supplied:

a) Must be at least 99.5%.

b) Will take into account all outages, except those scheduled.

c) Will be calculated as the ratio between the normal operating time of the communication circuit and the total observation time in one month.

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5.4.1.3 The **delay** shall be less than 60 ms for communications between locations listed in Appendix C, including propagation time in access and transportation networks.

5.4.1.4 The **RTT** for communications between two stations, for a 64-byte packet, may not exceed 150 ms in 95 % of the measurements made in a minimum time window of 10 seconds.

5.4.1.5 The bit error rate **(BER)** shall be less than $10^{-7}$ 99.5% of the time.

5.4.1.6 The Successful Bidder shall activate the **interfaces** required for AAA applications. The interfaces to be used may be digital routers and/or multiplexors and/or other devices that meet AAA needs.

5.4.2 **Specific technical characteristics**

5.4.2.1 The ground backbone of the REDDIG II will act as a multiservice infrastructure and shall be provided with a multiservice IP platform logically independent and isolated from any other network and, especially, from the public environment of the Internet.

5.4.2.2 The multiservice IP network shall permit the creation of VPNs using MPLS, in accordance with RFC 2547 and RFC 3031, and QoS configuration over MPLS/VPN, in accordance with RFC 3270 and RFC 2983.

5.4.2.3 These service quality assurances shall be implemented end-to-end.

5.4.2.4 In accordance with the required priorities and SLA levels, the different types of packets to be transmitted over the multiservice IP network shall be classified into at least five types of services, in accordance with RFC 2474 and RFC 2475 standards – DiffServ, supplemented with RFC 2597 – Assured Forwarding PHB and RFC 2598 – Expedited Forwarding, in addition to all the traffic explicitly defined in the aforementioned RFCs, as follows:

a) *Real time:* Applications sensitive to network delays and delay variations (*jitter*), which require packet prioritisation and band reservation.
b) *Critical mission*: Interactive applications which are critical for the traffic of critical operational information that requires guaranteed delivery and priority treatment.
c) *Management*: Network management applications, using ICMP, SNMP, Telnet, and other protocols.

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d) *Non-critical:* Applications with messages of varied size that do not require the immediate attention of users. Even if the content is important, these applications can wait until network resources are available.

e) *Standard*: All traffic not explicitly attributed to the aforementioned classes will be classified as standard, also known as ¨*best-effort*¨ type. This type of traffic can be transmitted if resources are available on the network and without a negative impact on the other classes.

| Real time | Critical mission | Management | Non-critical | Standard |
|---|---|---|---|---|
| Telephony | AFTN/AMHS/ | Network management (SNMP) | Intranet | FTP |
| Teleconferencing | AIDC | | | SMTP |
| Videoconferencing | ADS-B | | | |
| | Automated systems | | | |
| | Radar data | | | |
| | Traffic control (routing) | | | |

5.4.2.5 Appendix C contains the list of communication links required for the ground MPLS backbone, indicating the bandwidth for each site, taking into account the capacity required for the applications that will run on that network. The specified communication links contemplate the use of dedicated point-to-point circuits between the TE and the edge routers of the Successful Bidder.

5.4.2.6 The configuration of QoS mechanisms shall permit bandwidth reservation for real-time traffic, critical mission, management, and non-critical traffic, for each PP.

5.4.2.7 All the applications described have unique interface, rate and signalling characteristics that shall be confirmed on the technical visit of the Bidder during the site survey.

5.4.2.8 The traffic resulting from the use of any of the applications already classified shall be automatically prioritised, regardless of any reconfiguration made by the Successful Bidder. Classified applications shall be duly identified by ICAO/AAA so that the Successful Bidder may configure the respective prioritisation mechanisms as required.

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| 5.4.2.9 It is desirable for the REDDIG Administration to be able to configure the traffic classification mechanisms of the other TE applications, when and if necessary. | |
| 5.4.2.10 When the technicians of the Successful Bidder are the only ones that can configure the traffic classification mechanisms of the other applications, the Successful Bidder shall negotiate with ICAO/AAA a procedure to ensure such configuration within a maximum of 36 (thirty-six) hours of the request. | |
| 5.4.2.11 No-loss compression techniques may be applied, to the extent they do not have a negative impact on the quality of the information carried on the circuit. | |
| 5.4.2.12 Access circuits shall be supplied by the Successful Bidder in digital format all along their path outside the units of REDDIG II member organisations, regardless of the purpose of the information being carried. | |
| 5.4.2.13 The services provided shall support the various applications of the REDDIG II ground backbone and their technology shall be based on leading equipment brands and that meet market standards. | |
| 5.4.2.14 Due to the corporate nature of ICAO activities, the services covered by this bidding process shall further data security. | |
| 5.4.3 **Port capacity** | |
| 5.4.3.1 The speeds required for each PP of the ground MPLS backbone are listed in Appendix C to this section. | |
| **5.5 Routers** | |
| 5.5.1 **Basic equipment configuration** | |
| 5.5.1.1 All the routers supplied shall be of the same brand and meet all the basic specifications of this item. All the information required for accessing/handling the MIBs of such equipment via SNMPv2 shall be provided to ICAO. | |
| 5.5.1.2 All the equipment supplied by the Successful Bidder shall be described in its bid, indicating: brand, model, processor characteristics, memory (type and capacity), operating system, function to be performed by the proposed solution in the project, and location where the equipment shall be installed, in addition to other supplementary information deemed necessary for the proper | |

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| understanding of the bid.<br><br>5.5.1.3 All the TE installed at the PPs shall be compatible for voice traffic, and configured to support the indicated number of voice channels. It shall be updated in terms of operating system version, RAM memory and FLASH memory.<br><br>5.5.2 **Basic routers characteristics**<br><br>5.5.2.1 Routers shall have:<br><br>a) At least the minimum amount of memory required for all the functionalities required in this specification, in accordance with the recommendations of the manufacturer.<br>b) SNMP and MIB-II management protocols implemented in accordance with RFC 1157 and RFC 1213, respectively.<br>c) Gateway functionality for voice over IP, to comply with all the functionalities required for the ground MPLS backbone service.<br>d) The features required for the implementation of RTP/RTCP protocols and RTP header compression, in accordance with RFC 2508.<br><br>5.5.2.2 They shall permit:<br><br>a) The configuration of traffic prioritisation methods by type of protocol and by service in the TCP/IP protocol stack.<br><br>b) The implementation of the following filtering functions: selection of services, commands of the TCP/IP stack, and creation of address filtering tables.<br>c) The use of a protocol that permits the establishment of service classes, with band reservation, with guaranteed priority for critical applications, in accordance with the defined IP standards (RFCs).<br>d) Interoperability, including for VoIP, with Cisco routers of various types that already exist in the REDDIG nodes.<br><br>5.5.2.3 They shall have remote access functionality enabling at least five (5) simultaneous connections, using different levels of codes to restrict any configuration of equipment and commands that alters their operation.<br><br>5.5.2.4 Implementation of routing protocols:<br><br>a) RIPv1 (RFC 1058)<br>b) RIPv2 (RFCs 2453, 1723 and 1724)<br>c) EIGRP | |

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| d) OSPF version 2, in accordance with the following RFCs: RFC 2328, RFC 1793, RFC 1587 and RFC 2370), and<br>e) BGPv4, in accordance with RFCs 4271, 4272, 4360, 4374, 4451, 4456, 1966, 1997, 2796, 2439, 2858, 2918. | |
| 5.5.2.5 Each router shall be sized to support the applications of each PP, as defined in Appendix C to this document. | |
| 5.5.2.6 Each router shall be physically capable of implementing all the configurations of initial applications, as described in Appendix C. | |
| 5.5.2.7 Each router shall be physically capable of receiving interfaces for future expansions. | |
| 5.5.2.8 All documents may be subject to updates and replacement. Consequently, the Successful Bidder shall submit updated documentation when signing the contract. | |
| **5.6 Network management** | |
| 5.6.1 The Successful Bidder shall provide a proactive network management service not only on its backbone, but also on ICAO network accesses and on all WAN ports of the TE installed at the ICAO PPs, for the detection, routing and resolution of problems. | |
| 5.6.2 Notwithstanding the proactive network management service provided by the Successful Bidder, the ICAO network support management should be able to execute normal procedures for monitoring TE resources, for which the Successful Bidder must provide the necessary configuration for getting the required information in real time. | |
| 5.6.3 The ICAO Network Management shall have the necessary access to the TE for retrieving information on SNMP management and use of the ICMP protocol, with a view to the execution of procedures related to service quality and performance, and meeting the needs of the other management procedures used. | |
| 5.6.4 The ICAO Network Management shall have the reading codes for accessing configuration and traffic information of all the TE installed by the Successful Bidder. | |
| 5.6.5 Network management by the Successful Bidder shall be available 24 (twenty-four) hours a day / seven (7) days a week, with no interruptions. | |
| 5.6.6 Network management by ICAO shall include proactive action to | |

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| guarantee the contracted level of service in terms of delay, availability and performance of the Successful Bidder's network.<br><br>5.6.7 In case of failure in the accesses contracted by ICAO or in the TT installed in the PPs, the network management of the Successful Bidder shall begin the failure recovery process, recording the event and monitoring its resolution.<br><br>5.6.8 The Successful Bidder network management, following the procedures defined in this document, shall contact ICAO to report the lack of availability or failure identified, in order to quickly determine if the failure was the responsibility of ICAO/AAA.<br><br>5.6.9 ICAO shall access the Successful Bidder's site using codes that will be provided to it, in order to obtain information such as:<br><br>a) The ground backbone topology of REDDIG II, showing the status of all the equipment of the PST that implements the service.<br>b) Configuration data.<br>c) Periodic performance.<br>d) Record of problems.<br><br>5.6.10 This website shall permit tracking of records concerning problems and action taken to restore service, covering at least the last ninety (90) days, including the following information:<br><br>a) Record identification (number of call).<br>b) Date and time of call initiation (record).<br>c) Description of the problem.<br>d) Identification of claimant (name and phone number).<br>e) Date and time of termination of the call (end of call).<br>f) Action taken to resolve the problem.<br>g) Identification of the technician responsible for responding to the request.<br><br>5.6.11 The website shall contain information on the performance of the ground MPLS backbone, in text and/or in graphical form, obtained through the use of SNMP, ICMP or other network control protocol, including:<br><br>a) Identification of each TE.<br>b) Type of access (fibre, radio, satellite, etc.).<br>c) Reference period.<br>d) Band utilisation, by access, indicating traffic volume (bits and packets), by service class, and by time.<br>e) Rejection of packets.<br>f) Average rate of occupation of the access, per hour. | |

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| g) Delay between all PPs.<br>h) Jitter between all PPs.<br>i) Maximum error rate, by access (TE).<br><br>5.6.12 Performance information shall be available in graphs generated through time, at intervals of no more than five (5) minutes, showing maximum and average performance values for all contracted accesses and the Successful Bidder's backbone.<br><br>5.6.13 The Successful Bidder shall have a maximum of thirty (30) days after signing the contract to have the aforementioned website available, with all the information indicated in this item of the document.<br><br>**5.7 Technical qualification**<br><br>5.7.1 The Bidder shall submit documents to demonstrate that the PST to be subcontracted is authorised by the appropriate telecommunication regulatory bodies of each REDDIG II member State to provide the telecommunication services listed in this document.<br><br>5.7.2 The bid shall include documents with background information of the PST telecommunication engineers in charge of the implementation, maintenance and management of the contracted service, who shall demonstrate a minimum experience of three years in the management of telecommunication services.<br><br>5.7.3 Likewise, it shall submit documents showing the experience of the PST in multiservice IP network operations using MPLS technology, accompanied by a quality certificate approved by at least three (3) different network user companies with more than ten points connected to it.<br><br>**5.8 Contracting conditions**<br><br>5.8.1 In participating in the bidding process, the Bidder assures that it is aware of the technical characteristics specified in the tender.<br><br>5.8.2 The Bidder shall foresee, if deemed necessary, technical inspection visits to the equipment installation sites, where all additional information required will be obtained on site. The Bidder will be responsible for obtaining and using such information to specify in detail the materials and services to be used by the company in the design of the installation.<br><br>5.8.3 The Bidder shall request, at least five working days in advance, the necessary authorisation to inspect the sites of its interest, indicating any assistance required from the technical personnel of the node | |

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(AAA).

5.8.4 The bid shall include a table of prices for each communication circuit contained in the bid, in accordance with the model in Appendix C, showing the exact amount to be paid by ICAO to the PST for the monthly provision of the service.

5.8.5 ICAO may decide to purchase all or part of the services foreseen in this bidding process, and even decide not to purchase such services, based on the systems offered, the costs involved, and compliance with the specifications of this document.

5.8.6 The Bidder shall submit a proposed timetable for the activation of each location, for approval by ICAO. This timetable may be modified at the discretion of ICAO in such a way as to prioritise some locations in detriment of others.

5.8.7 The MPLS service contract will operate as follows:

a) If the Successful Bidder **IS** a telecommunication service provider, the contract shall be effective for five (5) years and shall be signed directly between the Successful Bidder and ICAO.
b) If the Successful Bidder **IS NOT** a telecommunication service provider, the Successful Bidder and the PST shall sign the initial contract for a period of six (6) months. At the end of that period, ICAO will sign a contract directly with the associated PST for the continued provision of services for the remainder of the period (4 ½ years). Therefore, the Bidders that are not service providers shall include in their bid a document where the selected PST guarantees the cost of the ground backbone for a five (5) year contract, the first six (6) months being paid by the Successful Bidder.

5.8.8 Accordingly, the bid shall include the following:

a) A single charge for PST installation (to be borne by the Successful Bidder)
b) PST service charges:
c) For the first six (6) months (to be borne by the Successful Bidder).
d) For the following fifty-four (54) months, to be borne by ICAO.

5.8.9 During the life of the contract, ICAO will be able to request extensions or terminations of communication services to meet ICAO needs, under the same cost conditions defined in the contract signed by the parties.

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| 5.8.10 Continued service provision shall start upon acceptance by ICAO of the installation and commissioning of all the PPs foreseen in this document, following the analyses conducted for fifteen (15) consecutive days. | |
| 5.8.11 In the event the Successful Bidder cannot deliver the services contracted in the timeframe foreseen, it may be subject to a fine of two per cent (2%) of the monthly value of the contract for each day of delay. | |
| 5.8.12 In its commercial bid, the Successful Bidder shall include information (tables or demos) identifying the methodology used for calculating the cost of activating the communication circuits, in order to allow ICAO to estimate the cost of modifying the contracted bands and including new circuits in the future. | |
| 5.8.13 For purposes of the monthly collection of charges for the services provided, the Successful Bidder (or the PST, as applicable) shall issue a bill for services rendered, segregating costs by PP. | |
| **5.9 Obligations of the successful bidder** | |
| 5.9.1 *Install, configure and start-up the* equipment required for the full provision of the contracted services, in accordance with that defined in this document. | |
| 5.9.2 *Comply* with the terms of this document in order to put the ground MPLS backbone of the REDDIG II in operating conditions. | |
| 5.9.3 *Operate and maintain* access circuits, providing the required technical assistance for full operation of the contracted service, in accordance with this document. | |
| 5.9.4 *Make* available to ICAO/AAA the products and services 24h (twenty-four hours) a day, seven days a week, except for scheduled interruptions for preventive maintenance previously notified to ICAO/AAA, and for acts of God and *force majeure*. | |
| 5.9.5 *Submit*, on a monthly basis for purposes of payment of contractual events, and together with the service bill, a technical report indicating outages and for each outage, the date and time of the call, the start and end of the attention, the identification of the problem, the measures taken and other relevant information, monthly availability, the value charged for each PP, as well as the respective discounts on account of interruptions, in accordance with that stipulated in this | |

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document.

5.9.6 *Ensure*, during and after the life of the contract, discretion and confidentiality in relation to the information it has access to regarding the installation, configuration and maintenance of its equipment and networks.

5.9.7 *Assume* responsibility for:

a) All obligations established in the specific legislation of each State on work accidents of its employees or third parties during the provision of, or in connection to, the services, at AAA units. In this regard, all the employees of the Successful Bidder or of subcontracted third parties shall always use individual protection equipment as foreseen in the legislation of each State.
b) Any damage caused by its employees to the property of ICAO/AAA or to third parties, whether by action or omission, including damages due to accidents in installed communication networks, and must proceed immediately to do the corresponding repairs and compensations, assuming all ensuing costs.
c) Immediately notifying ICAO/AAA of any extraordinary or abnormal fact that occurs in its working areas in relation to the contracted service, for the purpose of taking relevant action.

5.9.8 *Replace*, at the request of ICAO/AAA, and subject to due justification and analysis by the parties, any of the equipment units included in the contracted service, based on the need for new functionalities or on unsatisfactory performance.

**5.10 Installation and other supplies**

5.10.1 The responsibility for the installation of the communication circuits will lie exclusively on the Successful Bidder, and shall be fulfilled within the periods foreseen in this document.

5.10.2 The Successful Bidder shall:

a) Foresee and provide all the equipment, interfaces, software, infrastructure and configurations required for the perfect operation of the contracted object.
b) Include all equipment (radios, antennas, routers, cabling, software and any other resource required for the implementation of the service), including possible civil works in the facilities of the AAA.
c) Supply and install shields to protect its equipment against

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atmospheric discharges.

d) Install its equipment in its own racks, which should be accompanied by the other components required for the installation.

e) Ask ICAO about the feasibility of the installation proposed, including the selection of the appropriate location.

f) Maintain the service during the life of the contract.

5.10.3 The AAAs will provide the physical space required inside the Technical Rooms for the TE equipment, with the power outlet required for the installation.

5.10.4 The installation shall include:

a) Telephone and data wiring between the PST frame and the general distributor (DG) or ACC equipment (at the discretion of the AAA), especially the interconnection with the satellite backbone routing system (SR), including protection systems where applicable; and

b) Electrical wiring between the power outlet and the equipment rack of the Successful Bidder, including the respective circuit breakers and devices to protect against surges and atmospheric discharges. The Successful Bidder will be responsible for reviewing the characteristics of any existing devices that might be available.

5.10.5 The termination block model shall meet the standards of general AAA distributors.

5.10.6 If an emergency power supply (UPS) is not available, the Successful Bidder shall install all the devices necessary to keep the MPLS access in operation for at least two hours during conventional power outages.

5.10.7 When the Successful Bidder does not have ground access to any of the sites that make up the REDDIG II, it is acceptable to use, only for those sites and with the approval of ICAO, satellite links where the **delay** is not to exceed 300 m, while the RTT cannot exceed 600 m. In this case, the satellite used shall be different from the one used for the satellite backbone of the REDDIG II.

**5.11 Implementation period**

5.11.1 The Successful Bidder shall submit, within five (5) days of signing the contract, a “Service Implementation Plan” that shall be approved by ICAO and that takes into account the following requirements:

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a) The installation of all access points under the contract and the configuration of all ports shall be completed within sixty (60) days of the date of acceptance of the System Design Document (SDD) to be submitted by the Successful Bidder, in accordance with Section B of this document.
b) Designation of the technicians who will be responsible for coordinating the implementation of the services.

5.11.2 Taking into account the timetable of activities foreseen in the Service Implementation Plan, coordination meetings shall be conducted as frequently as defined by ICAO for the implementation of services.

5.11.3 The modification of port speeds and the resulting reconfigurations that may be required shall be done within five (5) calendar days as of the date of the formal request by ICAO/AAA.

5.11.4 In case there is a need to move the physical location of a PP of the ***REDDIG II ground backbone:***

a) ICAO/AAA shall request the change of address with a minimum of thirty (30) days in advance, and the Successful Bidder must indicate, within a maximum of seven (7) days, the time required to make the change.
b) The time period must not exceed:
   - Thirty (30) calendar days when the new location is in the same city and the appropriate telephone infrastructure is available.
   - Sixty (60) days when the change of address of a PP does not meet the conditions specified in the previous paragraph.
c) The cost of reinstallation of a PP may not exceed that proposed by the Bidder in the Installation Price column shown in the sample Commercial Bid -– REDDIG II ground backbone.

**5.12 Reception of circuits**

5.12.1 The Successful Bidder shall measure the established parameters during circuit implementation (in accordance with ITU-T), and shall also monitor them for 24 hours to show compliance with the established specifications.

5.12.2 At the discretion of ICAO, the aforementioned tests may be conducted using samples, and the Successful Bidder shall use its own instruments and tools, and have the necessary personnel available to conduct them under the supervision of ICAO/AAA.

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5.12.3 The Successful Bidder shall submit the results of the measurements done according to the previous paragraph, showing compliance with the required specifications, for approval by ICAO /AAA.

5.12.4 The technical representatives of ICAO/AAA may request the Successful Bidder to conduct a quality assessment of the circuits provided by the PST.

**5.13 Service outage discounts**

5.13.1 The Successful Bidder shall give a discount for communication service outages, provided:

a) The causes are the responsibility of ICAO/AAA.
b) The time frames established in this document for circuit maintenance and/or restoration to one hundred per cent (100%) of their operational capacity are not complied with.
c) It fails to report to ICAO/AAA the performance of preventive maintenance with the minimum anticipation foreseen in this document.

5.13.2 The Successful Bidder will apply, as described in this chapter, the following discounts on the monthly value of the inoperative PP:

a) For each hour or fraction of an hour of outage that exceeds the time periods defined under “Technical assistance” of this Section for the MPLS ground backbone; and
b) For the number of hours during which the circuit is inoperative due to preventive maintenance, if the contracted party fails to notify the contracting party of the performance of such maintenance duly in advance as specified in this document.

5.13.3 In case of recurring outage (i.e., having the same cause) within a period of less than twenty-four (24) hours as of the recovery from the last failure in a PP, the PP non-availability time will be considered as that between the start of the first failure until the end of the last failure, once the circuit if fully operational. If more than one failure occur in less than twenty-four (24) hours, but caused by different reasons (non-recurring), the Successful Bidder shall demonstrate to ICAO that the reasons are different, for purpose of non-cumulative calculation of downtime.

5.13.4 To calculate downtime of the PP, the following information shall be taken into account:

a) Start of failure: date and time of the failure.
b) Duration of the failure: date and time in which the ICAO/AAA

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technician declares the PP operation restored.

5.13.5 If the Successful Bidder is responsible for the outage, *outage discounts* will be applied *in accordance with the following equation (limited to the monthly value of the circuit)*:

$$I = \frac{T_i \times P}{T_o}$$

Where:

I = discount in USD, in relation to the failed PP.

$T_o$ = operating period (1 month) in minutes.

$T_i$ = total downtime of the PP during the operating period (1 month), in minutes.

P = monthly price of the PP in USD.

5.13.6 If the summation of downtimes (Ti) occurred in a given communication circuit results in an monthly availability index of less than 99.5%, penalties will be applied in accordance with the following equation, regardless of the discount established in the previous paragraph:

$$M = \frac{(T_i - 0{,}005 \times T_0)}{60} \times 0{,}01 \times P$$

Where:

M = penalty in USD, in relation to the failed PP not compliant with the contracted level of availability.

$T_o$ = operating period (1 month), in minutes.

$T_i$ = total downtime of the PP during the operating period (1 month), in minutes.

P = monthly price of the PP in USD.

5.13.7 All outages will be taken into account for calculating this summation, including those lasting less than the maximum PP recovery period, in accordance with "Technical assistance" of this document, for the MPLS ground backbone, taking into account:

a) Scheduled (preventive) outages notified to ICAO/AAA according to "Technical assistance" of this document will not be taken into account for calculating availability in the MPLS ground backbone.

b) Outages considered to be the responsibility of ICAO/AAA will not be taken into account for the calculation.

5.13.8 In case of partial outage (i.e., one or more applications are not available or are degraded, but there is no total PP outage), the downtime (Ti) described in the two equations of this chapter shall be

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considered to be half its value.

### 5.14 Network synchronisation

5.14.1 For network synchronisation purposes, the REDDIG II must provide, in each of its nodes, a GPS clock source, backed up by a crystal oscillator, with an accuracy of 1E-11.

5.14.2 Network synchronisation must comply with the ISO/IEC 11573 standard. The Bidder must take into account the elastic buffers required to achieve the design objectives of the ISO/IEC 11573 standard and of the ITU-G.822, taking into account that the REDDIG is an international network and that the clocks must be derived from the national networks in each node. If the node cannot be operated in plesiochronous mode, switching must be automatic.

5.14.3 The Bidder must include the network synchronisation plan in its bid. The plan must take into account the automatic mechanisms to maintain network synchronism in case of loss of the primary signal, as well as topology aspects to avoid loops and cascading of the clock signal.

## 6. TYPES OF SERVICES

### 6.1 General aspects

6.1.1 The REDDIG II must provide the necessary resources for establishing and supporting the described digital voice and data communications, in terms of interfaces and bandwidth required by:

a) The aeronautical fixed service (AFS), which involves the current air navigation services (ATS speech circuits and AFTN and AMHS data circuits), provided by ATS, AIS, COM, MET and SAR units, including radar information.
b) The new CNS/ATM (data) services.
c) Civil aviation authorities for purposes of administrative coordination, including voice and data.
d) REDDIG maintenance units for purposes of network maintenance coordination, including voice and data.

### 6.2 Voice communication aspects

6.2.1 The REDDIG must provide the resources for establishing a virtual switched telephony private network (VSTN) throughout its domain that ensures a proper operation with AAA communication networks and devices and meets voice communication requirements.

6.2.2 The VSTN must emulate the operation of a local and traffic switch,

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and provide services similar to those provided by PSTN (analogue telephony) and ISDN (digital telephony) networks.

6.2.3 The VSTN must have built-in resources for establishing switched calls and permanent clear channels, and for supporting operations with different interfaces and protocols.

6.2.4 The VSTN must provide communications with the following characteristics:

a) Full duplex communications with good voice quality, in accordance with recommendations ITU-T P.82 and G-114.
b) End-to-end voice signal delay not to exceed 400 ms, in accordance with recommendation ITU-T G.114.
c) PCM coding of the voice signal in accordance with Law A of recommendation ITU-T G.711.
d) High quality, compressed voice that permits an efficient use of the leased bandwidth. The voice compression algorithm must not mutilate nor distort the voice signal, and must be able to operate satisfactorily in circuits with high error rate. The voice compression algorithm must be based on standard coding methods (recommendations ITU-T G.728, G.729, G.729A, G.723.1).
e) Echo control using echo cancellers (recommendation ITU-T G.168) supplied for each VSTN circuit. Each echo canceller must have programmable parameters to control the operation (on/off), and echo ground round trip time (0 to 30 ms or more) in case the canceller does not have an adaptive compensation mechanism.
f) Direct switching of the compressed voice signal in the VSTN. Quantisation noise must not be added to switching by compression, decompression and/or A/D conversion in addition to those occurring in connection ends.
g) Imperceptible and controlled radio electric interference and cross-talk (ITU-T recommendations of the G, K and P series).
h) In accordance with the transmission plan and the characteristics recommended in ITU-T G.101, G.171 and G.712.

6.2.5 The VSTN must provide gateways to the (physical and virtual) networks for communications devices and networks of the AAA, using the interfaces described in Appendix B.

6.2.6 The VSTN must provide the following facilities:

a) Configuration of system operating characteristics using programmable parameters.
b) Flexible and programmable numbering plan.
c) Programmable hunting groups.
d) Closed user groups (CUG).

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e) Programmable service classes for each line (input and output).

f) Programmable tables for analysis, call routing, main and alternate routes, digit suppression, and automatic delivery of digits to trunks (*outpulsing*).

g) Selection of the analysis table according to circuit service class.

h) Phone book numbers of up to 8 digits, individually programmable for each port.

i) Automatic calls from any access port to the VSTN that requires this service, provided there is assurance of signalling upon termination of the connection.

j) Individual configuration of the associated interface type, operating mode and communication protocol at VSTN port level.

k) Operation with two-way, single output, single input trunks in DOD (*direct outward dialling*), DIL (*direct inward dialling*), DISA (*direct inward system access*) and DID (*direct inward dialling*) modes.

l) Individual configuration of primary multiplex channels (E1/CAS and T1/CAS)

m) Type of circuits: trunk E&M (E&M/E1, E&M/T1), trunk loop start (LS/E1, LS/T1), trunk ground start (GS/E1, GS/T1)), subscriber line (LU/E1, LU/T1), digital trunk circuit with 64-Kbps sub-multiplexing 3B+D (ECMA-253) and 6B+D (ECMA-289) with QSIG signalling (QSIG/D64U/E1 and QSIG/D64U/T1), and 64-Kbps clear channel (D64U/E1, D64U/T1):

n) The VSTN must provide the emulated circuit with the same processing it provides to the corresponding actual circuit (except for ABCD signalling-to-bit conversion).

o) Fixed, programmable routing between two VSTN ports.

p) Permanent, programmable circuits (clear channel with and without signalling) between two VSTN ports.

q) End-to-end transport of line and dialling information (in-band and off-band).

r) Teleconferencing for five (5) or more participants.

s) Facsimile support.

**6.3 Numbering plan**

6.3.1 The current numbering plan to be implemented has up to seven (7) digits, where the first digits identify the REDDIG node and the next two complete the selection.

6.3.2 The VSTN must be capable of migrating to a closed numbering scheme of eight (8) digits. The first three digits identify the REDDIG node and the remaining digits complete the selection.

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6.3.3 Each REDDIG node must be identified by a three (3) and two (2) digit code in accordance with the numbering plan used. These codes should not be transmitted unless the destination communication device provides traffic routing. The codes associated to the REDDIG nodes are as follows:

| REDDIG node | IDENTIFIER | CODE |
| --- | --- | --- |
| Argentina - Ezeiza | (SAEZ) | (7)20 |
| Bolivia - La Paz | (SLLP) | (7)25 |
| Brazil - Curitiba | (SBCT) | (7)30 |
| Brazil - Manaus | (SBMN) | (7)36 |
| Brazil - Recife | (SBRE) | (7)38 |
| Chile - Santiago | (SCEL) | (7)40 |
| Colombia - Bogotá | (SKED) | (7)45 |
| Ecuador - Guayaquil | (SEGU) | (7)50 |
| Guyana - Georgetown | (SYGC) | (7)90 |
| French Guiana - Cayenne | (SOCA) | (7)92 |
| Paraguay - Asunción | (SGAS) | (7)55 |
| Peru - Lima | (SPIM) | (7)60 |
| Suriname - Paramaribo | (SMPM) | (7)94 |
| Uruguay - Montevideo | (SUMU) | (7)65 |
| Venezuela - Maiquetía | (SVMI) | (7)80 |
| Trinidad and Tobago – Piarco | (TTZP) | (7)91 |

**6.4 Characteristics of voice communications**

6.4.1 The required direct voice communications involve instantaneous and switched communications.

6.4.2 The voice communication requirements for the Region are contained in the SAM Air Navigation Plan FASID, ICAO Doc 8733/14.

6.4.3 Appendix B to this document lists the harmonised requirements of the AFS voice communication plan, and provides detailed information on traffic, number of ports, types of interfaces, circuit protocols and other supplementary data.

6.4.4 When preparing its proposal, the Bidder must take into account the standards and recommendations contained in ICAO Annexes 10 and 14 and in circular 183-AN.

**6.5 Instantaneous communications**

6.5.1 The **VSTN must provide HOTLINE circuits for voice communications in order to establish communications between**

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| --- | --- |
| **air traffic controllers (ATCs).**<br><br>6.5.2 **HOTLINE circuits must have no blocking, and communications must be established immediately.**<br><br>**6.6 Switched communications**<br><br>6.6.1 Switched voice communication circuits must be established in the VSTN as a closed user group ATSa (CUG ATSa) with total access between its members.<br><br>6.6.2 The time for establishing a call must be less than five (5) seconds.<br><br>6.6.3 The level of service must be better than 0.005 (according to the *Erlang* B equation) during peak hour. Peak hour traffic must be calculated as 1.5 times total ATSa traffic, which must be calculated based on the tables in Appendix A, taking into account an average holding time of two (2) minutes.<br><br>6.6.4 Each REDDIG II node must use VSTN switched speech circuits as backup for instantaneous circuits. The number of these circuits is indicated in the tables of Appendix A to this document.<br><br>**6.7 Aspects of data communications**<br><br>6.7.1 The REDDIG II must provide, throughout its domain (REDDIG nodes), the resources for establishing a private, flexible, multi-protocol and wide-area network (WAN) based on IP technology that meets the operational data communication requirements of the services listed in Appendix B.<br><br>6.7.2 The WAN must guarantee proper operation with the communication networks and devices of each State.<br><br>**6.8 Management facilities**<br><br>a) Establish the operating characteristics of the network, circuits and ports, based on programmable parameters.<br>b) Define closed user groups in the networks, based on programmable parameters.<br>c) Define permanent virtual circuits and their operating characteristics, based on parameters.<br>d) Offer the possibility of VPN and Qos configuration.<br>e) Define the operating characteristics (circuit, protocol, address, speed, etc.), at individual and port level.<br>f) Define the routing plan. | |

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### 6.9 General aspects

6.9.1 The required data communications involve mainly the applications defined in Appendix B.

6.9.2 AFTN and AMHS communication requirements for the Region are contained in the FASID of the SAM Air Navigation Plan, ICAO Doc 8733/14.

6.9.3 The REDDIG II must ensure that the network latency time of an AFTN or AMHS message does not exceed fifteen (15) seconds in peak hour 95% of the time, and sixty (60) seconds 100% of the time. Peak hour traffic must be calculated as 1.5 times the traffic indicated in Appendix A to this document.

### 6.10 Characteristics of data communications

6.10.1 *Asynchronous circuits:*

a) Interfaces: ITU-T V.24. EIA RS 232C, RS 422.
b) Port configuration: DTE and DCE.
c) Speeds: 300 to 9600 bps.
d) Data bits: 5, 7 and 8 bits.
e) Start bit: 1 bit.
f) Stop bit: 1 and 2 bits.
g) Parity: even/odd/none.
h) Flow control: XON/XOFF. CTS/RTS, and data alone.

6.10.2 *Real-time synchronous clear channels:*

a) Interfaces: ITU-T V.24, V.35. EIA RS 232C, RS 422.
b) Port configuration: DTE and DCE.
c) Speeds: 2400 bps to 64 Kbps.
d) Flow control: CTS/RTS, and data alone.
e) Synchronisation: internal, external and recovered.

6.10.3 *Data transmission circuits of customer LAN networks:*

a) Interfaces: LAN 10/100 Base T.
b) Speed: 10/100 Mb/s.
c) Standard: ISO/IEC 8802.

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### 7. TECHNICAL PROPOSAL

### 7.1 General

7.1.1 The technical proposal of the Bidder shall consist of the following documents:

a) Volume I – "Description"
b) Volume II – "Statement of compliance"
c) Volume III – "Details of the supply of goods and services"
d) Volume IV – "Systems and equipment technical-operational manuals".

7.1.2 For purposes of assessment and technical qualification of the technical proposals, Bidders must submit three (3) complete sets of the aforementioned documents.

### 7.2 Satellite network

7.2.1 For the satellite network, the Bidders shall include the following in their technical proposals:

7.2.2 A general network design document that includes, *inter alia*:

a) The technical solution proposed, taking into account the integration with the ground network and the transition from the existing satellite network to the future mixed architecture
b) Types of transmission carriers
c) Transmission, modulation and coding mode
d) Link budget for all network nodes
e) Network power balance
f) Calculation of the total bandwidth of REDDIG II for the satellite being used (if that platform is chosen), or for another satellite, taking into account technical and operational requirements
g) Satellite and beam proposed, if different from the existing ones
h) List of network spare parts

7.2.3 Design documents for each node, including:

a) Power balance for each ground station
b) Equipment/spare parts for each node
c) Auxiliary equipment for each node
d) Block diagram of equipment interconnections
e) Redundancy requirements to ensure the failure tolerance

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required in this document

f) Tools and measuring equipment for each node

**7.3 Ground network**

7.3.1 For the ground network, the Bidders shall include the following in their technical bid:

7.3.2 A general network design document that includes, *inter alia*:

a) Technical solution proposed, taking into account its integration with the satellite network
b) Terminal equipment (TE) for each node, taking into account routers (Layers 3 and 1) of the ISO OSI reference.
c) The speed of the equipment installed in the access points.

7.3.3 Design documents for each node, including:

d) Block diagram of the interconnection between the equipment and the satellite backbone
e) Redundancy requirements to ensure failure tolerance as required in this document.
f) Radios, antennas, routers, cabling, software and any other resource necessary for the implementation of the service in each node, if applicable.
g) Details of any works done for the installation of the Bidder's equipment inside or outside the premises.

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### APPENDIX A – SUMMARY OF THE CURRENT REDDIG

**1. Services**

1.1 The REDDIG is a satellite network coordinated by the International Civil Aviation Organization (ICAO) on behalf of the States participating in Technical Cooperation Project RLA/03/901. The network provides high-quality voice and data services for sixteen nodes in fourteen countries of the CAR and SAM Regions.

1.2 The network uses VSAT (Very Small Aperture Terminal) technology with 3.7 m antennas for operating in band C, using the INTELSAT satellite IS-14. The REDDIG also supports the monitoring and control service - RC&M for an efficient management of network resources.

1.3 Voice services comprise three overlapping voice networks, namely: the two air traffic services - ATSd (hotline circuits) and ATSa (switched circuits), and administrative (switched services). Voice services have analogue (E&M, FXS, FXO) or digital (E1 CAS) interfaces, depending on local requirements.

1.4 User data services comprise four main networks. The service initially provided was for the AFTN (Aeronautical Fixed Telecommunication Network). There are also radar data circuits that use various protocols.

1.5 The RC&M service involves distributed (local and computer monitoring) and centralised (Network Control Centre - NCC) elements. Both the local and centralised services can be accessed remotely from any node. In order to provide redundancy to the Main Reference Terminal (MRT) there is a clear channel connection between the Ethernet ports of the Ezeiza and Manaus NCCs, through ground telecommunication service providers.

**2. Operating mode**

2.1 User services are connected to the REDDIG through dual Frame Relay access devices (FRAD). The FRAD provides a variety of ports and protocols required by the user for voice and data applications, enabling permanent or switched voice and data services. Services are multiplexed in a simple WAN interface, using the Frame Relay protocol. The MPS-FRAD gives priority to services in such a way

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that they can coexist in the same physical interface. Each FRAD defines a permanent virtual circuit (PVC) for each possible address.

2.2 Most user services are connected through FRAD switches that can also be connected directly to the satellite terminal. At locations where digital voice interfaces are used, this is the only FRAD required, with no need for a FRAD multiplex.

2.3 WAN access is provided through satellite terminal equipment that implements the MF-TDMA (*Multi-Frequency Time Division Multiple Access*). In contrast with conventional networks that use continuous carriers, TDMA operates in bursts, using an agile modulator in terms of time, frequency and symbol transmission rate. In the REDDIG, the modulators can transmit on any of the three available carriers. The REDDIG has two carriers that accommodate 1.25Msym/s each, and one carrier with half that rate, *i.e.*, 0.625Msym/s.

2.4 The MRT transmits a reference burst on the first carrier, which marks the beginning of the TDMA raster. All terminals receive this burst and are capable of establishing a time-based network for the transmission. Other time slots at the beginning of the TDMA raster are reserved for control, signalling and synchronisation bursts, and therefore these timeslots are not available for supporting user traffic.

2.5 When terminals transmit traffic, they use the same raster structure defined by the reference burst on a predefined time slot. Burst synchronism is precisely adjusted so as to ensure no burst overlap in a given frequency while going through the satellite transponder. Each terminal is aware of its distance to the satellite and thus has the possibility of making time corrections as needed. Figure 1 illustrates how REDDIG carriers assign time slots.

2.6 It is important to understand that each terminal, at any point in time, has only one simple modulator and demodulator. This means that there is only one burst in a given frequency in a given time slot. The same rule applies to the demodulator, which cannot receive two frequencies simultaneously. The smartest aspect of the MF-TDMA is considered to be the way in which the NCC manages the use of time slots and carriers in response to band requirements of virtual circuits. The NCC makes sure that the best use is made of satellite segment resources by all terminals in different time slots, through band grouping.

2.7 TDMA terminals support two types of permanent virtual circuits – *Frame Relay* (FR) and *Internet Protocol* (IP), the first being used for user applications, while the second is used for RC&M functions, using the Ethernet port of the TDMA modem.

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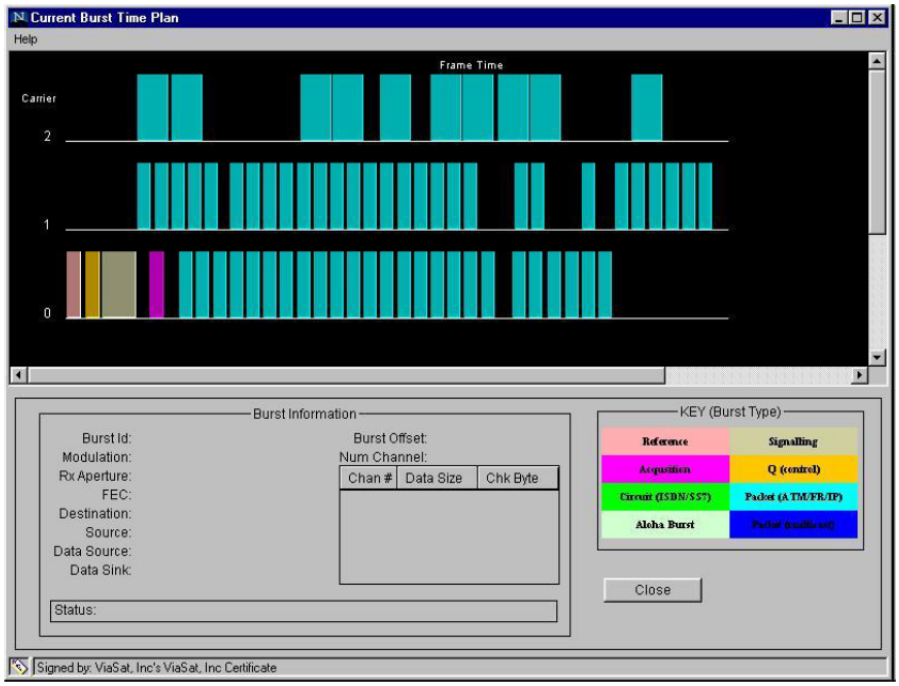


**Figure 1: Time slot assignment plan**

### 3. Hardware

3.1 TDMA networks consist of three types of elements: the NCC, the MRT and traffic terminals (TT). The NCC is a SUN station connected *via* Ethernet to the MRT. The MRTs and TTs are Linkway 2100 TDMA modems in the L band, configured for their functions within the network. The Linkway 2100 modem has an L band interface for interconnecting with the outdoor unit (ODU).

3.2 The network operates in the C band beam in the United States and Latin America, through the IS-14 satellite. The bandwidth leased from INTELSAT is 4.4MHz.

3.3 VSAT terminals are equipped with 1:1 redundancy chains. All the main equipment, such as the MUX-FRAD (where required), MPS-FRAD, TDMA modem, Cross-Site, Up-converter/SSPA, and the LNB are duplicated. Redundant switches (wave guide and base band) are electronically linked so that they or the A or B chain equipment can be selected.

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**4. Description of the terminal**

4.1 **General**

4.1.1 The terminal system consists of redundant equipment at each site, based on the same equipment, the basic difference being the number and type of interfaces. Terminals consist of an indoor rack (IDU) that contains the modems, interfaces, and console equipment, while outdoor equipment includes the antenna at the assembly site, the up-converter blocks, high-power amplifiers and low-noise receptors.

4.2 **Indoor equipment**

Data interface

4.2.1 Services are connected to the interfaces located in the back of the rack. The panel is provided with RJ11/12/45 interfaces, and has V.24 and V35 ports that use plus-type D. The base band interface switches the data between the two redundant pathways (Chains A and B). Switching of internal switches is controlled *via* the local monitoring and control PC, using the RS232/485 remote communication panel or the front panel controls.

Frame Relay Access Device (FRAD)

4.2.2 In the FRAD, each possible REDDIG node address is provided through PVCs. These circuits are loaded in the V.35 ports between the FRAD and the modem. FRADs are configured in such a way that packets of a user data port are switched to the corresponding PVC in such a way that data is transmitted to the correct user.

4.2.3 The FRADs used are Memore Cx950. The number of data interfaces at each node depends on the operational applications required. The MPS FRAD in each location is equipped with I/O penalty cards and another I/O card.

4.2.4 Regarding voice, nodes with digital interfaces are equipped with E1 cards. In nodes that only have analogue voice circuits, ports are defined by SLIM LID interfaces, such as FXS/FXO or E&M.

4.2.5 Each FRAD may have up to 8 interface cards. Sites equipped only with digital voice interfaces will only need one FRAD per chain, that is, the MPS FRAD (*Multiprotocol packet switching FRAD*). Sites equipped with analogue voice interfaces are required to have two FRADs per chain: an MPS and an MUX. The MUX FRAD

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(Multiplex FRAD) is used when more than one voice application is required.

TDMA modem

4.2.6 The TDMA modem modulates and demodulates FR packets in L band carriers. The equipment is capable of transmitting on any of the three frequencies available in multiple time slots, subject to NCC control. The modems used are of the VIASAT Linkway type.

4.3 **Outdoor equipment**

Antenna

4.3.1 The antenna is 3.7M in diameter designed and manufactured by the Northwest China Research Institute of Electronic Equipment (NWIEE). The antenna has an offset dual reflector axis for high gain, and low secondary lobes. The main reflector uses high-precision aluminium panels and a precise, reliable and appropriate frame to facilitate installation.

RF equipment

4.3.2 TDMA modem outputs are presented in L band in the back of the racks, wired to the outdoor equipment. Paradise Datacom up-converter blocks and amplifiers (SSPA) are located in the transmission pathways. The outputs of the two SSPAs are switched in such a way that the active chain is linked to the antenna feeder, while the other SSPA is in phantom load.

4.3.3 In the reception pathway, the signal that arrives to the antenna is filtered so as to reject transmission frequencies, and then switched before entering the LNB of the pathway in use. The LNB of the standby chain is connected to a phantom load. The signal is amplified and converted to the L band by a high-stability LNB before being sent to the TDMA modem.

SSPA

4.3.4 The SSPAs are Paradise Datacom HPAC 2040-CO 40W operating in C band. They include L band-to-C band conversion blocks, and use a 4.9Ghz phase locked oscillator for converting the L band input (950 - 1525MHz) to C band output (5.85 - 6.425GHz) prior to amplification.

LNB

4.3.5 The LNB is the NJS8477EN model manufactured by Japan Radio Co. It amplifies the C band signals (3.625 - 4.2GHz) received from

## SECTION C – TECHNICAL REQUIREMENTS

the satellite, and through local oscillator stirring, it generates the FI in the L band (1525- 950 MHz).

### APPENDIX B – SERVICES AND INTERFACES TO BE CONSIDERED

**1. Service requirements in support of air navigation in the Region (including those foreseen for the short, medium and long term)**

1.1 The list of service requirements to support air navigation in the SAM Region, including those foreseen for the short, medium and long term, to be carried on the two REDDIG backbones (satellite and ground MPLS), includes:

Current services:

1.2 Those resulting from the requirements contained in the CAR/SAM Air navigation Plan and which, at the present time, are almost fully operational, namely:

a) Table CNS1A (AFTN plan).
b) Table CNS1C (ATS direct speech circuit plan).

Future services:

a) Those resulting from the MEVA II – REDDIG interconnection.
b) Teleconferencing services for flow management units (FMUs) or flow management positions (FMPs), to be provided on a daily basis between all the units of the Region, initially for twenty users.
c) Exchange of flight plans and/or radar information, through conventional methods, in accordance with the respective MoUs (Memorandums de Understanding) signed or to be signed.
d) AMHS interconnection requirements, gradually replacing the AFTN service, in accordance with the respective MoUs (Memorandums de Understanding) signed or to be signed.
e) AIDC interconnection requirements, gradually replacing the ATS speech service.
f) The exchange of ADS-B data and multilateration between all ACCs of adjacent FIRs.
g) The interconnection of automated systems between all ACCs of adjacent FIRs, using Asterix 62 and 63.
h) AIM requirements: to date, there is no concrete requirement in this respect.

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**2. Interfaces and bandwidths required for supporting the specified requirements**

2.1 **Introduction**

2.1.1 This Chapter contains a detailed analysis of the various services that must be maintained (current) or provided (future) by the ATN, which serves to define the minimum interfaces of the routers to be installed in each State in the REDDIG II satellite backbone.

*Note*.— The interfaces required for the routers of the REDDIG II ground MPLS backbone are described in Appendix C to this PET.

2.1.2 The respective tables list the existing interfaces that are required to maintain the MEVA II – REDDIG integration. They also estimate the additional bandwidth that will be required from the REDDIG II for the new services, based on the tests conducted and other specified parameters.

2.1.3 Accordingly, the following services are described at the end of this Chapter:

a) Interfaces and additional bandwidth for the AFTN.
b) Interfaces and additional bandwidth for ATS speech communications.
c) Interfaces and additional bandwidth for the exchange of radar data.
d) Interfaces and additional bandwidth for teleconferencing.
e) Interfaces and additional bandwidth for AMHS.
f) Interfaces and additional bandwidth for AIDC.
g) Interfaces and additional bandwidth for the exchange between automated systems
h) Interfaces and additional bandwidth for ADS-B.

Summary of results

2.1.4 Based on the individual summaries of each of the aforementioned services, Tables 2-1 (Interfaces required for routers) and 2-2 (Estimated additional bandwidth) are presented below:

2.1.5 An Ethernet interface was added for interconnecting the routers of the satellite backbone.

*Note*.—The interfaces of the REDDIG II ground MPLS backbone, including Ethernet for the interconnection with the satellite backbone, are shown in Appendix C to the PET.

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Interfaces

| State | Location | Minimum interfaces | | | | | |
|---|---|---|---|---|---|---|---|
| | | Universal I/O | Ethernet | Digital | E&M | FXO | FXS |
| Argentina | Ezeiza | 11 | 2 | 0 | 11 | 0 | 1 |
| Bolivia | La Paz | 4 | 2 | 0 | 4 | 0 | 4 |
| Brazil | Curitiba | 4 | 2 | 0 | 6 | 2 | 1 |
| | Manaus | 6 | 2 | 0 | 7 | 0 | 5 |
| | Recife | 1 | 2 | 0 | 7 | 0 | 1 |
| Chile | Santiago | 2 | 2 | 0 | 8 | 0 | 0 |
| Colombia | Bogotá | 7 | 2 | 1 | 0 | 0 | 0 |
| Ecuador | Guayaquil | 3 | 2 | 1 | 0 | 0 | 0 |
| French Guiana | Rochambeau | 2 | 2 | 0 | 0 | 0 | 5 |
| Guyana | Georgetown | 4 | 2 | 0 | 0 | 0 | 5 |
| Paraguay | Asunción | 3 | 2 | 0 | 3 | 0 | 3 |
| Peru | Lima | 9 | 2 | 1 | 0 | 0 | 0 |
| Suriname | Paramaribo | 3 | 2 | 0 | 0 | 0 | 4 |
| Trinidad and Tobago | Piarco | 2 | 2 | 0 | 0 | 0 | 6 |
| Uruguay | Montevideo | 2 | 2 | 0 | 0 | 4 | 5 |
| Venezuela | Maiquetía | 10 | 2 | 0 | 7 | 0 | 4 |

**Table 2-1: Interfaces required for routers**

2.1.6 This Table can be modified only if:

a) Any of the Administrations decides to change the analogue voice interfaces for digital interfaces.
b) The exchange of radar signals is done using Universal I/O interfaces (DB25) instead of the Ethernet (RJ45).

Additional bandwidth

2.1.7 The rules for the preceding calculation have been explained in the respective texts, and from their implementation it may be assumed that the total estimate must be considered as referential.

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2.1.8 However, it should be noted that the portion no longer used in the AFTN should be deducted from the cited values, since the service is either AFTN or AMHS, and never in parallel.

2.1.9 Therefore, that value is inserted in the last lines of Table 2-2, as obtained from Table 2A-1, providing the net value of the bandwidth increase required.

| State | Location | Service (each in Kbps) | | | |
|---|---|---|---|---|---|
| | | AFTN | Radar | AMHS | ADS-B |
| Argentina | Ezeiza | | 76.8 | 28.8 | 19.2 |
| Bolivia | La Paz | | 115.2 | 14.4 | 19.2 |
| Brazil | Curitiba | | 76.8 | 19.2 | 19.2 |
| | Manaus | 9.6 | 134.4 | 33.6 | 19.2 |
| | Recife | | 0 | 4.8 | 19.2 |
| Chile | Santiago | | 57.6 | 9.6 | 19.2 |
| Colombia | Bogotá | 19.2 | 76.8 | 38.4 | 19.2 |
| Ecuador | Guayaquil | | 38.4 | 14.4 | 19.2 |
| French Guiana | Rochambeau | | 38.4 | 9.6 | 19.2 |
| Guyana | Georgetown | | 57.6 | 19.2 | 19.2 |
| Paraguay | Asunción | | 57.6 | 9.6 | 19.2 |
| Peru | Lima | 9.6 | 96 | 43.2 | 19.2 |
| Suriname | Paramaribo | | 76.8 | 14.4 | 19.2 |
| Trinidad and Tobago | Piarco | | 19.2 | 9.6 | 19.2 |
| Uruguay | Montevideo | | 19.2 | 9.6 | 19.2 |
| Venezuela | Maiquetía | | 76.8 | 38.4 | 19.2 |
| Partial (Kbps) | | 38.4 | 1017.6 | 316.8 | 307.2 |
| Global partial (Kbps) | | 1680 | | | |
| AFTN difference | | -103.2 | | | |
| **Net bandwidth increment** | | **1576.8** | | | |

**Table 2-2: Additional bandwidth estimate**

Additional bandwidth estimated for the REDDIG II: 1.576.8 Kbps

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### 2.2 Interfaces required and additional bandwidths – AFTN

2.2.1 In order to determine the **interfaces** required for satellite backbone routers, Table 2A-1 presents the AFTN circuits in the SAM Region and in Trinidad and Tobago, as member of REDDIG. The individual values for each circuit have been taken from the parameters established by the REDDIG management.

| AFTN TABLE | | | Speed (Kbps) | Installed interfaces |
|---|---|---|---|---|
| Argentina | Ezeiza | Bolivia (La Paz) MET | 1.2 | 9 |
| | | Paraguay (Asunción) MET | 2.4 | |
| | | Peru (Lima) MET | 1.2 | |
| | | Bolivia (La Paz) | 2.4 | |
| | | Chile (Santiago) | 2.4 | |
| | | Brazil (Curitiba) | 2.4 | |
| | | Paraguay (Asunción) | 2.4 | |
| | | Peru (Lima) | 2.4 | |
| | | Uruguay (Montevideo) | 2.4 | |
| Bolivia | La Paz | Argentina (Ezeiza) | 2.4 | 4 |
| | | Argentina (Ezeiza) MET | 1.2 | |
| | | Brazil (Curitiba) | 2.4 | |
| | | Peru (Lima) | 2.4 | |
| Brazil | Curitiba | Argentina (Ezeiza) | 2.4 | 4 |
| | | Uruguay (Montevideo) | 2.4 | |
| | | Paraguay (Asunción) | 2.4 | |
| | | Bolivia (La Paz) | 2.4 | |
| | Manaus | Colombia (Bogotá) | 2.4 | 6 |
| | | Colombia (Bogotá) - USA | 9.6 | |
| | | Guyana (Georgetown) | 2.4 | |
| | | French Guiana (Cayenne) | 2.4 | |
| | | Peru (Lima) | 2.4 | |
| | | Suriname (Paramaribo) | 2.4 | |
| | Recife | Venezuela (Maiquetía) | 2.4 | 1 |
| Chile | Santiago | Argentina (Ezeiza) | 2.4 | 2 |
| | | Peru (Lima) | 2.4 | |
| Colombia | Bogotá | Ecuador (Guayaquil) | 2.4 | 7 |
| | | Brazil (Manaus) - USA | 9.6 | |
| | | Brazil (Manaus) | 2.4 | |
| | | Peru (Lima) | 9.6 | |
| | | Peru (Lima) - USA | 2.4 | |
| | | Venezuela (Caracas) | 2.4 | |
| | | Panama (Panama) | 2.4 | |
| Ecuador | Guayaquil | Colombia (Bogotá) | 2.4 | 3 |
| | | Peru (Lima) | 2.4 | |
| | | Venezuela (Maiquetía) | 2.4 | |
| French Guiana | Cayenne | Venezuela (Maiquetía) | 2.4 | 2 |
| | | Brazil (Manaus) | 2.4 | |
| Guyana | Georgetown | Brazil (Manaus) | 2.4 | 4 |
| | | Suriname (Paramaribo) | 2.4 | |
| | | Trinidad and Tobago (Piarco) | 2.4 | |

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| | | | | |
|---|---|---|---|---|
| | | Venezuela (Caracas) | 2.4 | |

| AFTN TABLE | | | Speed (Kbps) | Installed interfaces |
|---|---|---|---|---|
| Panama | Panama | Colombia (Bogotá) | 2.4 | 1 |
| Paraguay | Asunción | Argentina (Ezeiza) | 2.4 | 3 |
| | | Argentina (Ezeiza) MET | 2.4 | |
| | | Brazil (Curitiba) | 2.4 | |
| Peru | Lima | Venezuela (Maiquetía) | 2.4 | 9 |
| | | Argentina (Ezeiza) | 2.4 | |
| | | Argentina (Ezeiza) MET | 1.2 | |
| | | Bolivia (La Paz) | 2.4 | |
| | | Brazil (Manaus) | 2.4 | |
| | | Chile (Santiago) | 2.4 | |
| | | Colombia (Bogotá) - USA | 9.6 | |
| | | Colombia (Bogotá) | 2.4 | |
| | | Ecuador (Guayaquil | 2.4 | |
| Suriname | Paramaribo | Brazil (Manaus) | 2.4 | 3 |
| | | Venezuela (Maiquetía) | 2.4 | |
| | | Guyana (Georgetown) | 2.4 | |
| Trinidad and Tobago | Piarco | Venezuela (Maiquetía) | 2.4 | 2 |
| | | Guyana (Georgetown) | 2.4 | |
| Uruguay | Montevideo | Argentina (Ezeiza) | 2.4 | 2 |
| | | Brazil (Brazilia) | 2.4 | |
| Venezuela | Maiquetía | Peru (Lima) | 2.4 | 10 |
| | | Ecuador (Guayaquil) | 2.4 | |
| | | Brazil (Recife) | 2.4 | |
| | | Colombia (Bogotá) | 2.4 | |
| | | Guyana (Georgetown) | 2.4 | |
| | | Suriname (Paramaribo) | 2.4 | |
| | | French Guiana (Cayenne) | 2.4 | |
| | | ACC Curaçao | 2.4 | |
| | | San Juan ACC | 2.4 | |
| | | Trinidad and Tobago (Piarco) | 2.4 | |
| Current AFTN bandwidth | | | 103.2 | |

**Table 2A-1: AFTN interfaces**

2.2.2 Bandwidth: The only two additional requirements are highlighted: 9.6 Kbps each, with final destination Atlanta (USA), both via Colombia (Bogotá), with ends in Brazil (Manaus) and Peru (Lima). Therefore, the additional AFTN bandwidth is 38.4 Kbps.

2.3 **Interfaces required and additional bandwidth – ATS speech circuits**

2.3.1 In order to determine the **interfaces** required for satellite backbone routers, Table 2B-1 on ATS speech service requirements in the SAM Region and in Trinidad and Tobago, as member of REDDIG, is shown below.

2.3.2 Likewise, for a better understanding, it includes both the circuits

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foreseen in Table CNS1C (direct and switched) as well as those actually installed in the REDDIG.

| ATS TABLE | | | ATS Requirements CNS1C | | | REDDIG | | Installed voice interfaces | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Direct | Switched | | Direct | Switch | Digital | E&M | FXO | FXS |
| | | | | Partial | Total | | | | | | |
| Argentina | Ezeiza | Bolivia (La Paz) | | 1 | 14 | | 5 | 0 | 11 | 0 | 1 |
| | | Chile (Santiago) | 1 | 6 | | 1 | | | | | |
| | | Brazil (Curitiba) | | 3 | | | | | | | |
| | | Paraguay (Asunción) | | 1 | | | | | | | |
| | | Uruguay (Montevideo) | 4 | 3 | | 4 | | | | | |
| | | Administrative | | | | | 2 | | | | |
| Bolivia | La Paz | Argentina (Buenos Aires) | | 1 | 7 | | 3 | 0 | 4 | 0 | 4 |
| | | Chile (Santiago) | | 1 | | | | | | | |
| | | Brazil (Manaus) | 1 | 1 | | 1 | | | | | |
| | | Brazil (Curitiba) | | 2 | | | | | | | |
| | | Paraguay (Asunción) | | 1 | | | | | | | |
| | | Peru (Lima) | 1 | 1 | | 1 | | | | | |
| | | Administrative | | | | | 3 | | | | |
| Brazil | Curitiba | Argentina (Buenos Aires) | | 3 | 9 | | 4 | 0 | 6 | 2 | 1 |
| | | Uruguay (Montevideo) | | 1 | | 1 | | | | | |
| | | Paraguay (Asunción) | | 3 | | 1 | | | | | |
| | | Bolivia (La Paz) | | 2 | | | | | | | |
| | | Administrative | | | | | 3 | | | | |
| | Manaus | Colombia (Bogotá) | | 1 | 7 | 3 | 3 | 0 | 7 | 0 | 5 |
| | | Guyana (Georgetown) | | 1 | | | | | | | |
| | | French Guiana (Cayenne) | | 1 | | | | | | | |
| | | Bolivia (La Paz) | | 1 | | 1 | | | | | |
| | | Venezuela (Maiquetía) | | 1 | | 1 | | | | | |
| | | Peru (Lima) | | 1 | | | | | | | |
| | | Suriname (Paramaribo) | | 1 | | | | | | | |
| | | Administrative | | | | | 4 | | | | |
| | Recife | Uruguay (Montevideo) | | 1 | 2 | | 5 | 0 | 7 | 0 | 1 |
| | | French Guiana (Cayenne) | | 1 | | | | | | | |
| | | Administrative | | | | | 3 | | | | |
| Chile | Santiago | Argentina (Buenos Aires) | 1 | 6 | 8 | 1 | 4 | 0 | 8 | 0 | 0 |
| | | Bolivia (La Paz) | | 1 | | | | | | | |

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| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Peru (Lima) | | 1 | | 1 | | | | | |
| | | Administrative | | | | | 2 | | | | |
| **ATS TABLE** | | | **ATS Requirements CNS1C** | | | **REDDIG** | | **Installed voice interfaces** | | | |
| | | | **Direct** | **Switched** | | **Direct** | **Switch** | **Digital** | **E&M** | **FXO** | **FXS** |
| | | | | **Partial** | **Total** | | | | | | |
| Colombia | Bogotá | Panama (Panama) | | 5 | 13 | 1 | 7 | 1 | 0 | 0 | 0 |
| | | Cenamer ACC | | 1 | | | | | | | |
| | | Kingston ACC | | 1 | | | | | | | |
| | | Curaçao ACC | | 1 | | | | | | | |
| | | Ecuador (Guayaquil) | 2 | 2 | | 1 | | | | | |
| | | Brazil (Manaus) | | 3 | | 3 | | | | | |
| | | Peru (Lima) | | 2 | | 1 | | | | | |
| | | Venezuela (Maiquetía) | | 1 | | 2 | | | | | |
| | | Administrative | | | | | 2 | | | | |
| Ecuador | Guayaquil | Colombia (Bogotá) | 2 | 2 | 3 | 1 | 4 | 1 | 0 | 0 | 0 |
| | | Peru (Lima) | | 1 | | 1 | | | | | |
| | | Cenamer ACC | | | | | | | | | |
| | | Administrative | | | | | 3 | | | | |
| French Guiana | Cayenne | Piarco ACC | | 1 | 4 | 1 | 2 | 0 | 0 | 0 | 5 |
| | | Brazil (Recife) | | 1 | | | | | | | |
| | | Brazil (Manaus) | | 1 | | | | | | | |
| | | Suriname (Paramaribo) | | 1 | | | | | | | |
| | | Administrative | | | | | 2 | | | | |
| Guyana | Georgetown | Piarco ACC | | 1 | 4 | 1 | 3 | 0 | 0 | 0 | 5 |
| | | Brazil (Manaus) | | 1 | | | | | | | |
| | | Suriname (Paramaribo) | | 1 | | | | | | | |
| | | Venezuela (Maiquetía) | | 1 | | | | | | | |
| | | Administrative | | | | | 1 | | | | |
| Panama | Panama | Colombia (Bogotá) | 3 | 2 | 3 | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Kingston ACC | | 1 | | | | | | | |
| | | Cenamer ACC | 2 | | | | | | | | |
| Paraguay | Asunción | Argentina (Buenos Aires) | | 1 | 4 | | 1 | 0 | 3 | 0 | 3 |
| | | Bolivia (La Paz) | | 1 | | | | | | | |
| | | Brazil (Curitiba) | 1 | 2 | | 1 | | | | | |
| | | Administrative | | | | | 4 | | | | |

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| ATS TABLE | | | ATS Requirements CNS1C | | | REDDIG | | Installed voice interfaces | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Direct | Direct | | Switch | Digital | E&M | FXO | FXS | |
| | | | | Partial | Total | | | | | | |
| Peru | Lima | Bolivia (La Paz) | | 1 | 6 | 1 | 5 | 1 | 0 | 0 | 0 |
| | | Brazil (Manaus) | | 2 | | | | | | | |
| | | Chile (Santiago) | | 1 | | 1 | | | | | |
| | | Colombia (Bogotá) | | 1 | | 1 | | | | | |
| | | Ecuador (Guayaquil | | 1 | | 1 | | | | | |
| | | Administrative | | | | | 3 | | | | |
| Suriname | Paramaribo | Brazil (Manaus) | | 1 | 4 | | 2 | 0 | 0 | 0 | 4 |
| | | French Guiana (Cayenne) | | 1 | | | | | | | |
| | | Guyana (Georgetown) | | 1 | | | | | | | |
| | | Piarco ACC | | 1 | | 1 | | | | | |
| | | Administrative | | | | | 1 | | | | |
| Trinidad and Tobago | Piarco | Guyana (Georgetown) | | 1 | 5 | 1 | 0 | 0 | 0 | 0 | 6 |
| | | Venezuela (Maiquetía) | | 1 | | 1 | | | | | |
| | | Suriname (Paramaribo) | | 1 | | 1 | | | | | |
| | | French Guiana (Cayenne) | | 1 | | 1 | | | | | |
| | | San Juan ACC | | 1 | | | | | | | |
| | | Administrative | | | | | 2 | | | | |
| Uruguay | Montevideo | Argentina (Buenos Aires) | 4 | 3 | 5 | 4 | 2 | 0 | 0 | 4 | 5 |
| | | Brazil (Recife) | | 1 | | | | | | | |
| | | Brazil (Curitiba) | | 1 | | 1 | | | | | |
| | | Administrative | | | | | 2 | | | | |
| Venezuela | Maiquetía | Piarco ACC | | 1 | 6 | 1 | 6 | 0 | 7 | 0 | 4 |
| | | Curaçao ACC | | 2 | | | | | | | |
| | | San Juan ACC | | 1 | | | | | | | |
| | | Brazil (Manaus) | | 1 | | 1 | | | | | |
| | | Colombia (Bogotá) | 2 | 3 | | 2 | | | | | |
| | | Guyana (Georgetown) | | 1 | | | | | | | |
| | | Administrative | | | | | 1 | | | | |

**Table 2B-1: Interfaces of the ATS speech service**

Additional ATS speech service bandwidth: there are no additional requirements for this service.

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### 2.4 Interfaces required and additional bandwidth – Radar data

2.4.1 In order to determine the **interfaces** required for the satellite backbone routers, Table 2C-1 on radar data exchange service provides total values for circuits leaving each State towards adjacent routers. It includes synchronous circuits (*via* DB25 ports) as well as those transmitted *via* Ethernet interfaces:

| Radar exchange towards automated centre | | | Signal generation | | | | Interfaces | |
|---|---|---|---|---|---|---|---|---|
| | | | Universal I/O | | Ethernet | | | |
| | | | Tx | Rx | Tx | Rx | Universal I/O | Ether. |
| Argentina | Ezeiza | Bolivia (La Paz) | 0 | TBD | 1 | TBD | TBD | 1 |
| | | Chile (Santiago) | 1 | 4 | 1 | TBD | 5 | |
| | | Brazil (Curitiba) | 0 | TBD | 1 | TBD | TBD | |
| | | Paraguay (Asunción) | 0 | TBD | 1 | TBD | TBD | |
| | | Uruguay (Montevideo) | 1 | 1 | 1 | TBD | 2 | |
| Bolivia | La Paz | Argentina (Buenos Aires) | TBD | TBD | TBD | TBD | 0 | 1 |
| | | Chile (Santiago) | TBD | TBD | TBD | TBD | TBD | |
| | | Brazil (Manaus) | TBD | TBD | TBD | TBD | TBD | |
| | | Brazil (Curitiba) | TBD | TBD | TBD | TBD | TBD | |
| | | Paraguay (Asunción) | TBD | TBD | TBD | TBD | TBD | |
| | | Peru (Lima) | TBD | TBD | TBD | TBD | TBD | |
| Brazil | Curitiba | Argentina (Buenos Aires) | TBD | TBD | TBD | TBD | TBD | 1 |
| | | Uruguay (Montevideo) | TBD | TBD | TBD | TBD | TBD | |
| | | Paraguay (Asunción) | TBD | TBD | TBD | TBD | TBD | |
| | | Bolivia (La Paz) | TBD | TBD | TBD | TBD | TBD | |
| | Manaus | Colombia (Bogotá) | TBD | TBD | TBD | TBD | TBD | 1 |
| | | Guyana (Georgetown) | TBD | TBD | TBD | TBD | TBD | |
| | | French Guiana (Cayenne) | TBD | TBD | TBD | TBD | TBD | |
| | | Bolivia (La Paz) | TBD | TBD | TBD | TBD | TBD | |
| | | Peru (Lima) | TBD | TBD | TBD | TBD | TBD | |
| | | Venezuela (Maiquetía) | TBD | TBD | TBD | TBD | TBD | |
| | | Suriname (Paramaribo) | TBD | TBD | TBD | TBD | TBD | |
| Chile | Santiago | Argentina (Buenos Aires) | 1 | 1 | 2 | TBD | 2 | 1 |
| | | Bolivia (La Paz) | TBD | TBD | TBD | TBD | TBD | |
| | | Peru (Lima) | TBD | TBD | TBD | TBD | TBD | |
| Colombia | Bogotá | Panama (Panama) (*) | TBD | TBD | TBD | TBD | TBD | 1 |
| | | Cenamer ACC (*) | TBD | TBD | TBD | TBD | TBD | |
| | | Kingston ACC (*) | TBD | TBD | TBD | TBD | TBD | |
| | | Curaçao ACC (*) | TBD | TBD | TBD | TBD | TBD | |
| | | Ecuador (Guayaquil) | TBD | TBD | TBD | TBD | TBD | |
| | | Brazil (Manaus) | TBD | TBD | TBD | TBD | TBD | |
| | | Peru (Lima) | TBD | TBD | TBD | TBD | TBD | |
| | | Venezuela (Maiquetía) | TBD | TBD | TBD | TBD | TBD | |
| Ecuador | Guayaquil | Colombia (Bogotá) | TBD | TBD | TBD | TBD | TBD | 1 |
| | | Peru (Lima) | TBD | TBD | TBD | TBD | TBD | |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| French Guiana | Cayenne | Brazil (Manaus) | TBD | TBD | TBD | TBD | TBD | 1 |
| | | Suriname (Paramaribo) | TBD | TBD | TBD | TBD | TBD | |

| Radar exchange towards automated centre | | | Signal generation | | | | Interfaces | |
|---|---|---|---|---|---|---|---|---|
| | | | Universal I/O | | Ethernet | | | |
| | | | Tx | Rx | Tx | Rx | Universal I/O | Ether. |
| | | | | | | | | |
| Guyana | Georgetown | Brazil (Manaus) | TBD | TBD | TBD | TBD | TBD | 1 |
| | | Suriname (Paramaribo) | TBD | TBD | TBD | TBD | TBD | |
| | | Venezuela (Maiquetía) | TBD | TBD | TBD | TBD | TBD | |
| Panama (*) | Panama (*) | Colombia (Bogotá) | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Kingston ACC (*) | | | | | | |
| | | Cenamer ACC (*) | | | | | | |
| Paraguay | Asunción | Argentina (Buenos Aires) | TBD | TBD | TBD | TBD | TBD | 1 |
| | | Bolivia (La Paz) | TBD | TBD | TBD | TBD | TBD | |
| | | Brazil (Curitiba) | TBD | TBD | TBD | TBD | TBD | |
| Peru | Lima | Bolivia (La Paz) | TBD | TBD | TBD | TBD | TBD | 1 |
| | | Brazil (Manaus) | TBD | TBD | TBD | TBD | TBD | |
| | | Chile (Santiago) | TBD | TBD | TBD | TBD | TBD | |
| | | Colombia (Bogotá) | TBD | TBD | TBD | TBD | TBD | |
| | | Ecuador (Guayaquil | TBD | TBD | TBD | TBD | TBD | |
| Suriname | Paramaribo | Brazil (Manaus) | TBD | TBD | TBD | TBD | TBD | 1 |
| | | French Guiana (Cayenne) | TBD | TBD | TBD | TBD | TBD | |
| | | Guyana (Georgetown) | TBD | TBD | TBD | TBD | TBD | |
| | | Piarco ACC | TBD | TBD | TBD | TBD | TBD | |
| Trinidad and Tobago | Piarco | San Juan ACC (*) | TBD | TBD | TBD | TBD | TBD | 1 |
| | | Venezuela (Maiquetía) | TBD | TBD | TBD | TBD | TBD | |
| Uruguay | Montevideo | Argentina (Buenos Aires) | 1 | 1 | TBD | TBD | 0 | 1 |
| | | Brazil (Brazilia) | TBD | TBD | TBD | TBD | TBD | |
| Venezuela | Maiquetía | Piarco ACC (*) | TBD | TBD | TBD | TBD | TBD | 1 |
| | | Curaçao ACC (*) | TBD | TBD | TBD | TBD | TBD | |
| | | San Juan ACC (*) | TBD | TBD | TBD | TBD | TBD | |
| | | Brazil (Manaus) | TBD | TBD | TBD | TBD | TBD | |
| | | Colombia (Bogotá) | TBD | TBD | TBD | TBD | TBD | |
| | | Guyana (Georgetown) | TBD | TBD | TBD | TBD | TBD | |

**Table 2C-1: Interfaces for the radar data exchange service**

(*): States or ACCs that do not belong to REDDIG. Although the interfaces have been foreseen, the required bandwidth will not be calculated.
TBD: To be determined.

Additional bandwidth

2.4.2 A quick look at the previous table shows that the additional bandwidth requirement for the exchange of radar data will depend exclusively on the Memorandums of Understanding (MoUs) signed or to be signed by the States.

2.4.3 In this regard, in order to have an initial estimate, it is foreseen that

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each State will, at least, transmit or receive data from a radar or synthesized information from adjacent States, and thus, the total amount of signals would be 106 (53 transmitted and 53 received).

2.4.4 Consequently, the following bandwidth increases described in Table 2C–2 shall be considered:

| **Radar exchange towards automated centre** | | **Total Tx/RX** | **BW (Kbps)** |
|---|---|---|---|
| Argentina (*) | Ezeiza | 8 | 76.8 |
| Bolivia | La Paz | 12 | 115.2 |
| Brazil | Curitiba | 8 | 76.8 |
| | Manaus | 14 | 134.4 |
| Chile | Santiago | 6 | 57.6 |
| Colombia (+) | Bogotá | 8 | 76.8 |
| Ecuador | Guayaquil | 4 | 38.4 |
| French Guiana | Cayenne | 4 | 38.4 |
| Guyana | Georgetown | 6 | 57.6 |
| Paraguay | Asunción | 6 | 57.6 |
| Peru | Lima | 10 | 96 |
| Suriname | Paramaribo | 8 | 76.8 |
| Trinidad and Tobago | Piarco | 2 | 19.2 |
| Uruguay (*) | Montevideo | 2 | 19.2 |
| Venezuela (+) | Maiquetía | 8 | 76.8 |
| **Total additional bandwidth** | | | **1017.6** |

**Table 2C-2: Bandwidth increases foreseen**

(*): For Argentina and Uruguay, the consumption corresponding to the exchange since 1999 has not been included, since it is part of the current REDDIG bandwidth.

(+): For Colombia and Venezuela, only the links with REDDIG States have been considered.

Additional bandwidth for radar data exchange: **1017.6 Kbps**

### 2.5 Interfaces required and additional bandwidth – Teleconferencing

2.5.1 Table 2D-1 identifies the **interfaces** that satellite backbone routers would require for teleconferencing services, indicating the flow management units/flow management positions that need to be interconnected.

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| **Teleconferencing** | | **FMU/ FMP (*)** | **Interfaces** | |
|---|---|---|---|---|
| | | | **E&M** | **Digital** |
| Argentina | Ezeiza | 1 | 1 | |
| | Mendoza | 1 | | |
| | Córdoba | 1 | | |
| | Resistencia | 1 | | |
| | Comodoro Rivadavia | 1 | | |
| Bolivia | La Paz | 1 | 1 | |
| Brazil | Curitiba | 1 | 1 | |
| | Manaus | 1 | | |
| | Atlántico | 1 | | |
| | Brasilia | 1 | | |
| | Recife | 1 | | |
| Chile | Santiago | 1 | | 1 |
| | Puerto Montt | 1 | | |
| | Punta Arenas | 1 | | |
| Colombia | Bogotá | 1 | | 1 |
| | Cali | 1 | | |
| | Medellín | 1 | | |
| | Barranquilla | 1 | | |
| Ecuador | Guayaquil | 1 | | 1 |
| French Guiana | Rochambeau | 1 | 1 | |
| Guyana | Georgetown | 1 | 1 | |
| Paraguay | Asunción | 1 | 1 | |
| Peru | Lima | 1 | 1 | |
| Suriname | Paramaribo | 1 | 1 | |
| Trinidad and Tobago | Piarco | 1 | 1 | |
| Uruguay | Montevideo | 1 | 1 | |
| Venezuela | Maiquetía | 1 | 1 | |

**Table 2D-1: Interfaces required (in existence) for teleconferencing**

2.5.2 **Additional bandwidth for teleconferencing:** It is estimated that, for this non-permanent service, the interfaces and the remaining bandwidth capacity of the REDDIG are sufficient to meet the demand, event at peak voice and data traffic; thus, **additional bandwidth is not required**.

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2.6 **Interfaces required and additional bandwidth– AMHS**

Additional bandwidth

2.6.1 Table 2E-4 below shows the conventional **AMHS connectivity** of the SAM Region and Trinidad and Tobago.

2.6.2 Likewise, in order to estimate the additional bandwidth, the primary conclusions of the tests done between Manaus and Ezeiza have been adopted, that is, to assign 4.8 Kbps between each pair of States, with the exception of messages originating (or switched) in Brazil and Peru to the US (Atlanta) and that will travel between each of the aforementioned States and Colombia (Bogotá), to enter the MEVA II at this latter site up to its final destination, *via* Miami, to which an additional 9.6 Kbps was assigned to the 4.8 Kbps already assigned to traffic between each pair of States.

2.6.3 Consequently, the bandwidth assigned between Brazil (Manaus) – Colombia (Bogotá) and Peru (Lima) – Colombia (Bogotá) is 14.4 Kbps (9.6 Kbps + 4.8 Kbps). These values have been inserted in column BW (Kbps).

| AMHS TABLE | | | BW (Kbps) |
|---|---|---|---|
| Argentina | Ezeiza | Bolivia (La Paz) | 4.8 |
| | | Chile (Santiago) | 4.8 |
| | | Brazil (Curitiba) | 4.8 |
| | | Paraguay (Asunción) | 4.8 |
| | | Peru (Lima) | 4.8 |
| | | Uruguay (Montevideo) | 4.8 |
| Bolivia | La Paz | Argentina (Ezeiza) | 4.8 |
| | | Brazil (Curitiba) | 4.8 |
| | | Peru (Lima) | 4.8 |
| Brazil | Curitiba | Argentina (Ezeiza) | 4.8 |
| | | Uruguay (Montevideo) | 4.8 |
| | | Paraguay (Asunción) | 4.8 |
| | | Bolivia (La Paz) | 4.8 |
| | Manaus | Colombia (Bogotá) (*) | 14.4 |
| | | Guyana (Georgetown) | 4.8 |
| | | French Guiana (Cayenne) | 4.8 |
| | | Peru (Lima) | 4.8 |
| | | Suriname (Paramaribo) | 4.8 |
| | Recife | Venezuela (Maiquetía) | 4.8 |
| Chile | Santiago | Argentina (Ezeiza) | 4.8 |
| | | Peru (Lima) | 4.8 |

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| AMHS TABLE | | | BW (Kbps) |
|---|---|---|---|
| Colombia | Bogotá | Ecuador (Guayaquil) | 4.8 |
| | | Brazil (Manaus) (*) | 14.4 |
| | | Peru (Lima) (*) | 14.4 |
| | | Venezuela (Caracas) | 4.8 |
| Ecuador | Guayaquil | Colombia (Bogotá) | 4.8 |
| | | Peru (Lima) | 4.8 |
| | | Venezuela (Maiquetía) | 4.8 |
| French Guiana | Cayenne | Venezuela (Maiquetía) | 4.8 |
| | | Brazil (Manaus) | 4.8 |
| Guyana | Georgetown | Brazil (Manaus) | 4.8 |
| | | Suriname (Paramaribo) | 4.8 |
| | | Trinidad and Tobago (Piarco) | 4.8 |
| | | Venezuela (Caracas) | 4.8 |
| Paraguay | Asunción | Argentina (Ezeiza) | 4.8 |
| Peru | Lima | Venezuela (Maiquetía) | 4.8 |
| | | Argentina (Ezeiza) | 4.8 |
| | | Bolivia (La Paz) | 4.8 |
| | | Brazil (Manaus) | 4.8 |
| | | Chile (Santiago) | 4.8 |
| | | Colombia (Bogotá) (*) | 14.4 |
| | | Ecuador (Guayaquil | 4.8 |
| Suriname | Paramaribo | Brazil (Manaus) | 4.8 |
| | | Venezuela (Maiquetía) | 4.8 |
| | | Guyana (Georgetown) | 4.8 |
| Trinidad and Tobago | Piarco | Venezuela (Maiquetía) | 4.8 |
| | | Guyana (Georgetown) | 4.8 |
| Uruguay | Montevideo | Argentina (Ezeiza) | 4.8 |
| | | Brazil (Brazilia) | 4.8 |
| Venezuela | Maiquetía | Peru (Lima) | 4.8 |
| | | Ecuador (Guayaquil) | 4.8 |
| | | Brazil (Recife) | 4.8 |
| | | Colombia (Bogotá) | 4.8 |
| | | Guyana (Georgetown) | 4.8 |
| | | Suriname (Paramaribo) | 4.8 |
| | | French Guiana (Cayenne) | 4.8 |
| | | Trinidad and Tobago (Piarco) | 4.8 |
| | | | 316.8 |

**Table 2E-4: AMHS connectivity and bandwidth calculation**

(*): As already stated, the combined traffic between each pair of States (Brazil – Colombia and Peru – Colombia) is added to the traffic originating in Peru and Brazil but which continues to Miami/Atlanta, via MEVA II.

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Estimated additional AMHS bandwidth: **316.8 Kbps**

2.7 **Interfaces required and additional bandwidth – AIDC** Interfaces

2.7.1 Table 2F-1 on the future AIDC service in the SAM Region and Trinidad and Tobago is shown below.

2.7.2 The table shows the number of services that should leave each State to the adjacent routers, whether for ACC/ACC, ACC/APP or APP/TWR communications.

| AIDC TABLE | | | Number | Total | Ethernet Interfaces |
|---|---|---|---|---|---|
| Argentina | Buenos Aires | Bolivia (La Paz) | 1 | 5 | 1 |
| | | Chile (Santiago) | 7 | | |
| | | Brazil (Curitiba) | 3 | | |
| | | Paraguay (Asunción) | 1 | | |
| | | Uruguay (Montevideo) | 7 | | |
| Bolivia | La Paz | Argentina (Buenos Aires) | 1 | 6 | 1 |
| | | Chile (Santiago) | 1 | | |
| | | Brazil (Manaus) | 1 | | |
| | | Brazil (Curitiba) | 2 | | |
| | | Paraguay (Asunción) | 1 | | |
| | | Peru (Lima) | 1 | | |
| Brazil | Curitiba | Argentina (Buenos Aires) | 3 | 4 | 1 |
| | | Uruguay (Montevideo) | 1 | | |
| | | Paraguay (Asunción) | 3 | | |
| | | Bolivia (La Paz) | 2 | | |
| | Manaus | Colombia (Bogotá) | 1 | 7 | 1 |
| | | Guyana (Georgetown) | 1 | | |
| | | French Guiana (Rochambeau) | 1 | | |
| | | Bolivia (La Paz) | 1 | | |
| | | Venezuela (Maiquetía) | 1 | | |
| | | Peru (Lima) | 1 | | |
| | | Suriname (Paramaribo) | 1 | | |
| | Recife | Uruguay (Montevideo) | 1 | 2 | 1 |
| | | French Guiana (Rochambeau) | 1 | | |
| Chile | Santiago | Argentina (Buenos Aires) | 7 | 3 | 1 |
| | | Bolivia (La Paz) | 1 | | |
| | | Peru (Lima) | 1 | | |
| Colombia | Bogotá | Panama (Panama) | 5 | 5 | 1 |
| | | Ecuador (Guayaquil) | 4 | | |
| | | Brazil (Manaus) | 3 | | |
| | | Peru (Lima) | 2 | | |
| | | Venezuela (Maiquetía) | 1 | | |
| Ecuador | Guayaquil | Colombia (Bogotá) | 4 | 2 | 1 |
| | | Peru (Lima) | 1 | | |

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| AIDC TABLE | | | Number | Total | Ethernet Interfaces |
|---|---|---|---|---|---|
| French Guiana | Rochambeau | Piarco ACC | 1 | 4 | 1 |
| | | Brazil (Recife) | 1 | | |
| | | Brazil (Manaus) | 1 | | |
| | | Suriname (Paramaribo) | 1 | | |
| Guyana | Georgetown | Piarco ACC | 1 | 4 | 1 |
| | | Brazil (Manaus) | 1 | | |
| | | Suriname (Paramaribo) | 1 | | |
| | | Venezuela (Maiquetía) | 1 | | |
| Paraguay | Asunción | Argentina (Buenos Aires) | 1 | 3 | 1 |
| | | Bolivia (La Paz) | 1 | | |
| | | Brazil (Curitiba) | 3 | | |
| Peru | Lima | Bolivia (La Paz) | 1 | 5 | 1 |
| | | Brazil (Manaus) | 2 | | |
| | | Chile (Santiago) | 1 | | |
| | | Colombia (Bogotá) | 1 | | |
| | | Ecuador (Guayaquil | 1 | | |
| Suriname | Paramaribo | Brazil (Manaus) | 1 | 4 | 1 |
| | | French Guiana (Rochambeau) | 1 | | |
| | | Guyana (Georgetown) | 1 | | |
| | | Piarco ACC | 1 | | |
| Trinidad and Tobago | Piarco | Guyana (Georgetown) | 1 | 4 | 1 |
| | | Venezuela (Maiquetía) | 1 | | |
| | | Suriname (Paramaribo) | 1 | | |
| | | French Guiana (Cayenne) | 1 | | |
| Uruguay | Montevideo | Argentina (Buenos Aires) | 7 | 3 | 1 |
| | | Brazil (Recife) | 1 | | |
| | | Brazil (Curitiba) | 1 | | |
| Venezuela | Maiquetía | Piarco ACC | 1 | 4 | 1 |
| | | Brazil (Manaus) | 1 | | |
| | | Colombia (Bogotá) | 5 | | |
| | | Guyana (Georgetown) | 1 | | |

**Table 2F-1: AIDC service**

## SECTION C – TECHNICAL REQUIREMENTS

Bandwidth

2.7.3 Regarding this service, there are 3 exchange modalities:

a) *Via* AFTN
b) *Via* AMHS
c) Direct between automated systems, *via* the ATN, through IP.

2.7.4 For the *first two cases*, AFTN messages are generated/received by automated systems and travel over the respective AFTN or AMHS systems (or a combination of the two). Thus, the increase in information will be reflected merely as an increase in the number of AFTN messages that will circulate over the ATN.

2.7.5 Since ATS traffic has historically accounted for only 15% of total AFTN traffic, if we hypothetically triple (300%) ATS messages, it will only be reflected in a 30% increase of AFTN traffic.

2.7.6 For the *third case*, each centre will send the information to the corresponding adjacent centre, and the increase in bandwidth will depend on the number of control messages that each automated centre generates, which obviously depends on the surrounding air traffic.

2.7.7 Likewise:

a) As the service is installed in the different States, the need for more bandwidth for this service will gradually and slightly increase.
b) The greatest bandwidth demand will occur when this service has been fully disseminated in the Region, while the *temporary* obligation to continue transferring flight orally persists.
c) Once this phase concludes, with the phase out of voice communications, bandwidth consumption will start decreasing until there is no longer a need for voice circuits.

2.7.8 At that moment, the net bandwidth (increase in AIDC – reduction in ATS speech service) will be negative; that is, the bandwidth requirement will decrease.

Additional AIDC bandwidth: Additional bandwidth is not required for this service.

2.8 **Interfaces required and additional bandwidth – Exchange between automated systems**

## SECTION C – TECHNICAL REQUIREMENTS

Interfaces

2.8.1 Table 2G-1 below refers to the exchange of data between automated systems, using Asterix 62 and 63 for the SAM Region and Trinidad and Tobago.

| Interconnection of automated systems | | | Number | Total | Ethernet |
|---|---|---|---|---|---|
| Argentina | Ezeiza | Bolivia (La Paz) | 1 | 6 | 1 |
| | | Chile (Santiago) | 1 | | |
| | | Brazil (Curitiba) | 1 | | |
| | | Paraguay (Asunción) | 1 | | |
| | | Uruguay (Montevideo) | 1 | | |
| Bolivia | La Paz | Argentina (Buenos Aires) | 1 | 6 | 1 |
| | | Chile (Santiago) | 1 | | |
| | | Brazil (Manaus) | 1 | | |
| | | Brazil (Curitiba) | 1 | | |
| | | Paraguay (Asunción) | 1 | | |
| | | Peru (Lima) | 1 | | |
| Brazil | Curitiba | Argentina (Buenos Aires) | 1 | 4 | 1 |
| | | Uruguay (Montevideo) | 1 | | |
| | | Paraguay (Asunción) | 1 | | |
| | | Bolivia (La Paz) | 1 | | |
| | Manaus | Colombia (Bogotá) | 1 | 8 | 1 |
| | | Guyana (Georgetown) | 1 | | |
| | | French Guiana (Cayenne) | 1 | | |
| | | Argentina (Buenos Aires) | 1 | | |
| | | Bolivia (La Paz) | 1 | | |
| | | Peru (Lima) | 1 | | |
| | | Venezuela (Maiquetía) | 1 | | |
| | | Suriname (Paramaribo) | 1 | | |
| Chile | Santiago | Argentina (Buenos Aires) | 1 | 3 | 1 |
| | | Bolivia (La Paz) | 1 | | |
| | | Peru (Lima) | 1 | | |
| | | Panama (Panama) | 1 | | 1 |
| | | Ecuador (Guayaquil) | 1 | | |
| | | Brazil (Manaus) | 1 | | |
| | | Peru (Lima) | 1 | | |
| | | Venezuela (Maiquetía) | 1 | | |
| Ecuador | Guayaquil | Colombia (Bogotá) | 1 | 2 | 1 |
| | | Peru (Lima) | 1 | | |
| French Guiana | Rochambeau | Piarco ACC | 1 | 3 | 1 |
| | | Brazil (Manaus) | 1 | | |
| | | Suriname (Paramaribo) | 1 | | |
| Guyana | Georgetown | Piarco ACC | 1 | 4 | 1 |
| | | Brazil (Manaus) | 1 | | |
| | | Suriname (Paramaribo) | 1 | | |
| | | Venezuela (Maiquetía) | 1 | | |
| Paraguay | Asunción | Argentina (Buenos Aires) | 1 | 3 | 1 |
| | | Bolivia (La Paz) | 1 | | |
| | | Brazil (Curitiba) | 1 | | |
| Peru | Lima | Bolivia (La Paz) | 1 | 5 | 1 |
| | | Brazil (Manaus) | 1 | | |
| | | Chile (Santiago) | 1 | | |
| | | Colombia (Bogotá) | 1 | | |
| | | Ecuador (Guayaquil | 1 | | |

## SECTION C – TECHNICAL REQUIREMENTS

| Interconnection of automated systems | | | Number | Total | Ethernet |
|---|---|---|---|---|---|
| Suriname | Paramaribo | Brazil (Manaus) | 1 | 4 | 1 |
| | | French Guiana (Rochambeau) | 1 | | |
| | | Guyana (Georgetown) | 1 | | |
| | | Piarco ACC | 1 | | |
| Trinidad and Tobago | Piarco | Venezuela (Maiquetía) | 1 | 1 | 1 |
| Uruguay | Montevideo | Argentina (Buenos Aires) | 1 | 2 | 1 |
| | | Brazil (Brasilia) | 1 | | |
| Venezuela | Maiquetía | Piarco ACC | 1 | 4 | 1 |
| | | Brazil (Manaus) | 1 | | |
| | | Colombia (Bogotá) | 1 | | |
| | | Guyana (Georgetown) | 1 | | |

**Table 2G-1: Exchange of data between automated centres**

Bandwidth

2.8.2 The evolution of the ratio between the use of the new service and the bandwidth required reflects the same analogy as for the AIDC service, namely:

a) As the service is installed in the various States, the need for more bandwidth for this service will gradually and slightly increase.
b) The greatest bandwidth demand will occur when this service has been fully disseminated in the Region, while the *temporary* obligation to continue transmitting ¨from radar to automated centre¨ persists.
c) Once this phase concludes, the net bandwidth (increase due to exchange between centres – reduction in the traditional form) will be negative, that is, the bandwidth requirement will decrease or, at the most, will be the same.

2.9 **Conclusion**

2.9.1 Additional bandwidth for the exchange between automated centres**:** Additional bandwidth is not required for this service.

2.10 **Operational requirements of the MEVAII/REDDIG interconnection**

2.10.1 The operational requirements between the CAR/SAM Regions are reflected in Table 2H-1.

## SECTION C – TECHNICAL REQUIREMENTS

**Tabla No. 1 – Resumen de los requisitos de interoperabilidad CAR/SAM**

| No. | Estado/Estación | ARUBA, Aruba | COLOMBIA | Barranquilla | Bogota | Cali | Medellin | San Andrés | ECUADOR, Guayaquil | JAMAICA, Kingston | NETHERLANDS A. Curacao | PANAMÁ, Panamá | PUERTO RICO, San Juan | VENEZUELA | Caracas | Josefa Camejo | COCESNA, Tegucigalpa | Total por Estado |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 1 | **ARUBA**, Aruba | | | | | | | | | | | | | | | V | | 1 Voz |
| 2 | **COLOMBIA** | | | | | | | | | | | | | | | | | 8 Voz + 1 Datos |
| 2.1 | Barranquilla | | | | | | | | | V | V | V | | | | | | |
| 2.2 | Bogotá | | | | | | | | | | | D,V | | | | | V | |
| 2.3 | Cali | | | | | | | | | | | V | | | | | | |
| 2.4 | Medellín | | | | | | | | | | | V | | | | | | |
| 2.5 | San Andrés | | | | | | | | | | | V | | | | | | |
| 3 | **ECUADOR**, Guayaquil | | | | | | | | | | | | | | | | V | 1 Voz |
| 4 | **JAMAICA**, Kingston | | | V | | | | | | | | | | | | | | 1 Voz |
| 5 | **NETHERLANDS A.** Curacao | | | V | | | | | | | | | | | D,V | | | 2 Voz + 1 Datos |
| 6 | **PANAMÁ**, Panamá | | | V | D,V | V | V | V | | | | | | | | | | 5 Voz + 1 Datos |
| 7 | **PUERTO RICO**, San Juan | | | | | | | | | | | | | | D,V | | | 1 Voz + 1 Datos |
| 8 | **VENEZUELA** | | | | | | | | | | | | | | | | | 3 Voz + 2 Datos |
| 8.1 | Caracas | | | | | | | | | | D,V | | D,V | | | | | |
| 8.2 | Josefa Camejo | V | | | | | | | | | | | | | | | | |
| 9 | **COCESNA**, Tegucigalpa | | | | V | | | | V | | | | | | | | | 2 Voz |
| | **Total por Estación** | 1 Voz | | 3 Voz | 2 Voz + 1 Datos | 1 Voz | 1 Voz | 1 Voz | 1 Voz | 1 Voz | 2 Voz + 1 Datos | 5 Voz + 1 Datos | 1 Voz + 1 Datos | | 2 Voz + 2 Datos | 1 Voz | 2 Voz | |

**Table 2H-1: CAR/SAM operational requirements**

2.10.2 Table 2H-2 illustrates the data requirements between the NAM and SAM Regions.

**Tabla No. 2 – Resumen de requisitos de interoperabilidad NAM/SAM**

| No. | Servicio de comunicación | Tipo |
|---|---|---|
| 1 | 2 | 3 |
| 1 | Circuito troncal AFTN **BRASIL**, Brasilia – **ESTADOS UNIDOS** | Datos |
| 2 | Circuito troncal AFTN **PERÚ**, Lima – **ESTADOS UNIDOS** | Datos |
| 3 | Circuito troncal AFTN **VENEZUELA**, Caracas – **ESTADOS UNIDOS** | Datos |
| 4 | Interconexión No. 1 de encaminadores ATN (Plan en revisión) | Datos |
| 5 | Interconexiones No. 2 de encaminadores ATN (Plan en revisión) | Datos |
| 6 | Otros futuros servicios | Datos |

**Table 2H-2: Data requirements between the NAM and SAM Regions**

## SECTION C – TECHNICAL REQUIREMENTS

### APPENDIX C – GROUND MPLS BACKBONE PARAMETERS

**Interfaces and router access speeds**

| State | Location indicator | Access speed (Kbps) | Minimum interfaces | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Serial | Ethernet | E 1 | E&M | FXO | FXS |
| Argentina | SAEZ | 256kbps | 6 | 2 | 0 | 6 | 0 | 1 |
| Bolivia | SLLP | 256kbps | 2 | 2 | 0 | 2 | 0 | 2 |
| Brazil (Curitiba) | SBCT | 256kbps | 2 | 2 | 0 | 3 | 1 | 1 |
| Brazil (Recife) | SBMN | 256kbps | 3 | 2 | 0 | 4 | 0 | 3 |
| Brazil (Manaus) | SBRF | 256kbps | 1 | 2 | 0 | 4 | 0 | 1 |
| Chile | SCEL | 256kbps | 1 | 2 | 0 | 4 | 0 | 0 |
| Colombia | SKED | 256kbps | 4 | 2 | 1 | 0 | 0 | 0 |
| Ecuador | SGAS | 256kbps | 2 | 2 | 1 | 0 | 0 | 0 |
| French Guiana | SOCA | 256kbps | 1 | 2 | 0 | 0 | 0 | 3 |
| Guyana | SYGC | 256kbps | 2 | 2 | 0 | 0 | 0 | 3 |
| Paraguay | SGAS | 256kbps | 2 | 2 | 0 | 2 | 0 | 2 |
| Peru | SPIM | 256kbps | 5 | 2 | 1 | 0 | 0 | 0 |
| Suriname | SMPM | 256kbps | 2 | 2 | 0 | 0 | 0 | 2 |
| Trinidad and Tobago | TTZP | 256kbps | 1 | 2 | 0 | 0 | 0 | 3 |
| Uruguay | SUMU | 256kbps | 2 | 2 | 0 | 0 | 2 | 3 |
| Venezuela | SVMI | 256kbps | 5 | 2 | 0 | 4 | 0 | 2 |

**Template to be completed by the Bidders**

| Point of presence (PP) | Location indicator | kbit/s | Price of access (USD) | Price of backbone (USD) | Equipment leasing (USD) | Installation price (USD) |
|---|---|---|---|---|---|---|
| Argentina | SAEZ | 256 | | | | |
| Bolivia | SLLP | 256 | | | | |
| Brazil (Curitiba) | SBCW | 256 | | | | |
| Brazil (Recife) | SBRE | 256 | | | | |
| Brazil (Manaus) | SBMN | 256 | | | | |
| Chile | SCEL | 256 | | | | |
| Colombia | SKED | 256 | | | | |
| Ecuador | SEGU | 256 | | | | |
| French Guiana | SOCA | 256 | | | | |
| Georgetown | SYGC | 256 | | | | |
| Paraguay | SGAS | 256 | | | | |

## SECTION C – TECHNICAL REQUIREMENTS

| Point of presence (PP) | Location indicator | kbit/s | Price of access (USD) | Price of backbone (USD) | Equipment leasing (USD) | Installation price (USD) |
|---|---|---|---|---|---|---|
| Peru | SPIM | 256 | | | | |
| Suriname | SMPM | 256 | | | | |
| Uruguay | SUMU | 256 | | | | |
| Trinidad & Tobago | TTZP | 256 | | | | |

## SECTION C – TECHNICAL REQUIREMENTS

### APPENDIX D – SUMMARY OF THE SUPPLY

A summary is presented below:

a) Supply for the satellite backbone
b) Supply for the ground backbone
c) Interfaces to be installed in each satellite backbone router
d) Interfaces to be installed in each satellite backbone router

**Summary of the satellite backbone supplied**

| Summary of the satellite backbone supplied | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| State (AAA) | Site (REDDIG II node) | Routing system | | VSAT system | | | Network management | |
| | | Switch | Router | Antenna | ODU (RFU) | IDU (modem) | NMS | NCC |
| Argentina | Ezeiza | TBD | 2 | 1 | 2 | 2 | 1 | 1 |
| Bolivia | La Paz | TBD | 2 | 1 | 2 | 2 | 1 | 0 |
| Brazil | Curitiba | TBD | 2 | 1 | 2 | 2 | 1 | 0 |
| Brazil | Manaus | TBD | 2 | 1 | 2 | 2 | 1 | 1 |
| Brazil | Recife | TBD | 2 | 1 | 2 | 2 | 1 | 0 |
| Chile | Santiago | TBD | 2 | 1 | 2 | 2 | 1 | 0 |
| Colombia | Bogotá | TBD | 2 | 1 | 2 | 2 | 1 | 0 |
| Ecuador | Guayaquil | TBD | 2 | 1 | 2 | 2 | 1 | 0 |
| French Guiana | Rochambeau | TBD | 2 | 1 | 2 | 2 | 1 | 0 |
| Guyana | Georgetown | TBD | 2 | 1 | 2 | 2 | 1 | 0 |
| Paraguay | Asunción | TBD | 2 | 1 | 2 | 2 | 1 | 0 |
| Peru | Lima | TBD | 2 | 1 | 2 | 2 | 1 | 0 |
| Suriname | Paramaribo | TBD | 2 | 1 | 2 | 2 | 1 | 0 |
| Trinidad and Tobago | Piarco | TBD | 2 | 1 | 2 | 2 | 1 | 0 |
| Uruguay | Montevideo | TBD | 2 | 1 | 2 | 2 | 1 | 0 |
| Venezuela | Maiquetía | TBD | 2 | 1 | 2 | 2 | 1 | 0 |

TBD: according to the criterion of the Bidder

## SECTION C – TECHNICAL REQUIREMENTS

**Summary of the ground backbone supplied**

| Summary of the ground backbone supplied | | |
|---|---|---|
| **State (AAA)** | **Site (REDDIG II node)** | **Terminal equipment (ET)** |
| Argentina | Ezeiza | TBD |
| Bolivia | La Paz | TBD |
| Brazil | Curitiba | TBD |
| Brazil | Manaus | TBD |
| Brazil | Recife | TBD |
| Chile | Santiago | TBD |
| Colombia | Bogotá | TBD |
| Ecuador | Guayaquil | TBD |
| French Guiana | Rochambeau | TBD |
| Guyana | Georgetown | TBD |
| Paraguay | Asunción | TBD |
| Peru | Lima | TBD |
| Suriname | Paramaribo | TBD |
| Trinidad and Tobago | Piarco | TBD |
| Uruguay | Montevideo | TBD |
| Venezuela | Maiquetía | TBD |

TBD: according to the criterion of the Bidder, in order to ensure availability requirements.

## SECTION C – TECHNICAL REQUIREMENTS

**Summary of interfaces to be installed in each satellite backbone router**

| Satellite backbone | | | | | | | |
|---|---|---|---|---|---|---|---|
| **State (AAA)** | **Site (Node)** | **Interfaces in each router** | | | | | |
| | | **Universal I/O** | **Ethernet** | **Digital** | **E&M** | **FXO** | **FXS** |
| Argentina | Ezeiza | 11 | 2 | 0 | 11 | 0 | 1 |
| Bolivia | La Paz | 4 | 2 | 0 | 4 | 0 | 4 |
| Brazil | Curitiba | 4 | 2 | 0 | 6 | 2 | 1 |
| Brazil | Manaus | 6 | 2 | 0 | 7 | 0 | 5 |
| Brazil | Recife | 1 | 2 | 0 | 7 | 0 | 1 |
| Chile | Santiago | 2 | 2 | 0 | 8 | 0 | 0 |
| Colombia | Bogotá | 7 | 2 | 1 | 0 | 0 | 0 |
| Ecuador | Guayaquil | 3 | 2 | 1 | 0 | 0 | 0 |
| French Guiana | Rochambeau | 2 | 2 | 0 | 0 | 0 | 5 |
| Guyana | Georgetown | 4 | 2 | 0 | 0 | 0 | 5 |
| Paraguay | Asunción | 3 | 2 | 0 | 3 | 0 | 3 |
| Peru | Lima | 9 | 2 | 1 | 0 | 0 | 0 |
| Suriname | Paramaribo | 3 | 2 | 0 | 0 | 0 | 4 |
| Trinidad and Tobago | Piarco | 2 | 2 | 0 | 0 | 0 | 6 |
| Uruguay | Montevideo | 2 | 2 | 0 | 0 | 4 | 5 |
| Venezuela | Maiquetía | 10 | 2 | 0 | 7 | 0 | 4 |

## SECTION C – TECHNICAL REQUIREMENTS

**Summary of interfaces to be installed in each ground backbone router**

| Ground backbone | | | | | | | |
|---|---|---|---|---|---|---|---|
| State | Site (Node) | Interfaces in each router | | | | | |
| | | Serial | Ethernet | E1 | E&M | FXO | FXS |
| Argentina | Ezeiza | 6 | 2 | 0 | 6 | 0 | 1 |
| Bolivia | La Paz | 2 | 2 | 0 | 2 | 0 | 2 |
| Brazil (Curitiba) | Curitiba | 2 | 2 | 0 | 3 | 1 | 1 |
| Brazil (Recife) | Manaus | 3 | 2 | 0 | 4 | 0 | 3 |
| Brazil (Manaus) | Recife | 1 | 2 | 0 | 4 | 0 | 1 |
| Chile | Santiago | 1 | 2 | 0 | 4 | 0 | 0 |
| Colombia | Bogotá | 4 | 2 | 1 | 0 | 0 | 0 |
| Ecuador | Guayaquil | 2 | 2 | 1 | 0 | 0 | 0 |
| French Guiana | Rochambeau | 1 | 2 | 0 | 0 | 0 | 3 |
| Guyana | Georgetown | 2 | 2 | 0 | 0 | 0 | 3 |
| Paraguay | Asunción | 2 | 2 | 0 | 2 | 0 | 2 |
| Peru | Lima | 5 | 2 | 1 | 0 | 0 | 0 |
| Suriname | Paramaribo | 2 | 2 | 0 | 0 | 0 | 2 |
| Trinidad and Tobago | Piarco | 1 | 2 | 0 | 0 | 0 | 3 |
| Uruguay | Montevideo | 2 | 2 | 0 | 0 | 2 | 3 |
| Venezuela | Maiquetía | 5 | 2 | 0 | 4 | 0 | 2 |

## SECTION D – SPARE PARTS, ACCESSORIES, TEST EQUIPMENT & TECHNICAL DOCUMENTATION

### 1. SPARE PARTS

1.1 The Bidder shall propose and offer a spare part lot to ensure full operation for a period of two (2) years, with a non-failure rate of the lot equal to or better than 95% per year. The amount assigned for such spare part lots shall be at least 5% of the total budget for the equipment.

1.2 The Project Office reserves the right to select and purchase, based on the total budget defined for the spare part lot, the parts it deems most appropriate in accordance with the list recommended by the manufacturer. The request for spare parts prepared by the Project Office shall be delivered to the Successful Bidder duly in advance, before starting the final acceptance test. The spare part lot shall be delivered to the Project Office for verification before the final acceptance tests are completed.

1.3 The list of spare parts to be submitted by the Bidders shall be that recommended by the manufacturers of the supplied systems and equipment. The list shall include the manufacturer's part number, description and unit cost, and shall contain:

a) Consumable parts: printer ink cartridges, batteries, protective varnish and grease, dust filters and others, whose life exceeds the period of the technical guarantee required in this document.
b) Replaceable parts: equipment, modules, blocks, cards.
c) Components: fuses, coaxial cables, data cables, waveguides, etc.
d) *Software*: CD-ROM back-up copies of supplied programmes.

1.4 Spare parts shall be supplied individually, duly identified, and packaged for long-term storage.

1.5 The Successful Bidder shall undertake to notify the Project Office, duly in advance, of those parts that will no longer be manufactured and of the replacements that would be available, if any.

1.6 The Successful Bidder shall supply a spare part lot for guarantee fulfilment. The spare parts used during the guarantee period shall be replaced with new ones.

1.7 The Successful bidder shall guarantee the availability of the spare parts, at least during the lifetime of the systems.

## SECTION D – SPARE PARTS, ACCESSORIES, TEST EQUIPMENT & TECHNICAL DOCUMENTATION

### 2. MEASURING EQUIPMENT AND TOOLS

2.1 The Bidder shall include in its proposal one (1) complete set of tools (software, accessories, connectors, cables, etc.) and measuring equipment as required and/or recommended by the manufacturers of the supplied systems and equipment, that will permit the Buyer to perform advance maintenance in the field.

2.2 The "testing equipment and measuring instruments" mentioned in the previous paragraph shall be quoted as "optional". The quote shall include transportation cases.

2.3 Additionally, the Bidder shall quote the following as "optional":

a) One (1) portable spectrum analyser of up to 26.5 GHz, equipped with: wave analyser, analogue and digital modulator, synthesised vector generator with tracking, calibration cables, measurement, set of attenuators for C band, and the types of connectors supplied with REDDIG II equipment. Transportation case.
b) Two (2) portable LAN/WAN network protocol analysers, built-in traffic generator, BER meter, cables and adaptors compatible with the interfaces supplied in REDDIG II.
c) Two (2) units for testing telephone line transmission: balanced impedance of 600 Ohms, including a variable generator, frequency and decibel metres with high- and low-impedance settings, DC terminator.

### 3. Technical documentation

#### 3.1 General

3.1.1 This chapter specifies the characteristics of the technical documentation that the Bidder shall quote in its technical proposal with respect to the supply.

3.1.2 The purpose of these documents is to give the Project Office detailed information about the installation, operation, maintenance and update (*hardware and software*) of each piece of equipment, subsystem and system supplied.

3.1.3 All documentation shall be supplied in Spanish and in English.

3.1.4 All technical information shall be submitted to the Project Office on a timely manner, before provisional acceptance testing (PSAT), and in sufficient detail to maximise their use.

## SECTION D – SPARE PARTS, ACCESSORIES, TEST EQUIPMENT & TECHNICAL DOCUMENTATION

3.2 **Documentation to be provided**

3.2.1 The types of technical documentation to be submitted include:

a) Training manuals
b) Network manual of operations and maintenance Technical manuals
c) Service bulletins and letters
d) Civil works
e) Installation of supply and interconnection diagrams
f) Updates and technical improvements
g) Licences

3.2.2 Training manuals, technical manuals, service bulletins and letters shall be sent in hard copy and in a storage medium (CD, DVD, pen-drive, etc.) preferably in PDF format (Adobe Acrobat).

3.2.3 The documentation on civil works, installation of the supply, interconnection and update diagrams, and technical improvement shall be submitted in hard copy and in a digital storage medium (CD, diskette, etc.) preferably in AutoCAD.

3.2.4 In general, all documentation shall be prepared with good-quality materials, in order to ensure long duration under continuous use and facilitate their use (remove and insert pages).

3.3 **Training manual**

3.3.1 Training manuals for instructors and students are intended to serve as training and study documents for the courses and technical-practical training sub-programmes indicated in this document.

3.3.2 The training manuals for students and instructors require the approval of the Project Office. The Successful Bidder shall submit a training manual to the Project Office for its approval.

3.3.3 The manuals for the students shall explain in detail each of the topics contained therein, with illustrations to facilitate understanding. The texts shall contain sufficient detail as to permit the training of individuals who did not attend the courses.

3.3.4 The instructor manuals shall contain, in addition to that stated in the previous paragraphs, the multimedia presentation for conducting the course.

3.3.5 The Successful Bidder shall supply five (5) instructor manuals and forty (40) student manuals, in Spanish and English, as specified in this document.

## SECTION D – SPARE PARTS, ACCESSORIES, TEST EQUIPMENT & TECHNICAL DOCUMENTATION

### 3.4 Technical manuals

3.4.1 Technical manuals are aimed at providing the user (AAA) with the required and adequate information for the proper installation, operation and maintenance of each piece of equipment, sub-system, system and software supplied.

3.4.2 The Successful Bidder shall supply, at each node, a complete set of technical manuals for the software, systems, subsystems and equipment that make up the supply. The Successful Bidder shall also supply an additional set of technical manuals to the Project Office. Likewise, it shall deliver supplementary or quick-reference manuals addressing basic maintenance functions.

3.4.3 Each technical manual shall correspond exactly to the make, model, type and version of the equipment, subsystem, system and/or software supplied. The manuals supplied shall correspond to engineering manuals of the highest level.

3.4.4 Minimum content of the manuals:

a) Hardware and software operating theory.
b) Functional description of the software, system, subsystem, equipment, module and cards.
c) Technical and functional specifications.
d) Installation, start up and tests.
e) Handling of control panels, interpretation of display panels.
f) Operation, protocols and commands of the software, equipment, subsystem and system.
g) Troubleshooting.
h) Diagnostic, testing and emergency procedures.
i) Configuration and standard values.
j) Settings and programming.
k) Preventive maintenance programme.
l) List of spare parts and parts.
m) Assembly and disassembly.
n) Recommended instruments and accessories.
o) Diagrams of:
   - Assembly of cabinets, equipment, modules and cards.
   - Location of modules and card components.
   - Functional blocks of systems, subsystems, equipment, modules and cards.
   - Full details of electrical circuits in cabinets, equipment, modules and cards.
   - (Software) flow diagrams.
p) Troubleshooting charts.

## SECTION D – SPARE PARTS, ACCESSORIES, TEST EQUIPMENT & TECHNICAL DOCUMENTATION

3.5 **Service bulletins and letters**

3.51 The purpose of these documents is to keep up to date all technical information that the Project Office has concerning the supplied equipment and software.

3.52 The manufacturer of the supplied hardware and software shall provide timely and detailed information on all and each change made to improve performance and/or resolve deficiencies in the supply. The manufacturer shall provide this service during the useful life of the equipment. The Successful Bidder shall be responsible for ensuring the provision of this documentation.

3.6 **Civil works**

3.61 The civil works proposed by the Bidder shall be described in detail in its technical proposal.

3.62 The Successful Bidder, once completed the works, shall supply the Project Office with the work files, consisting of printed diagrams and computer files (AutoCAD) of the plant view, architecture, location of equipment, raceways, etc.

3.7 **Installation**

3.71 The purpose of the documentation prepared by the Successful Bidder on the installation work at the sites is to ensure that the details of the work done (or to be done) are the result of proper coordination between the Successful Bidder and the Project Office.

3.72 The Successful Bidder shall submit to the Project Office for approval, and for each REDDIG II node, the technical file of the installation, which includes, at least:

a) Equipment location diagrams and computer files,
b) Cabling, interconnection cards, etc.
c) The programme and detailed timetable of activities to be carried out.

3.73 The Project Office, based on the technical files of the facilities, will develop its work supervision programme.

3.74 The Successful Bidder, once the works have been completed, shall provide the Project Office with the updated technical file of the installation.

## SECTION E – SERVICES, TESTS AND ACCEPTANCE

### TIMETABLE

The Bidder shall present a detailed timetable of activities, which shall include at least the following landmarks:

a) Site survey (performed during tendering stage)
b) Signing of the Contract (T0)
c) Delivery of SDD

d) FAT satellite backbone
e) Dispatch to the site (to each AAA)
f) Installation and training

g) PSAT ground backbone
h) PSAT satellite backbone
i) NAT satellite backbone

j) FSAT
k) Guarantee starting date

### 1. SERVICE EXPENSES and DAILY SUBSISTENCE ALLOWANCES (DSA)

1.1 In general, the tenderer's proposal shall include the cost for airfare (economy class), travel medical insurance, terminal transportation costs (airport to hotel and return), Visas and DSA based on a UN standard rate, to all national or civil aviation authorities participating at factory acceptance tests, factory training, or other project travel expenses as may be required under this specification. Said DSA shall be paid out to the beneficiaries by the eventual contractor. This DSA rate shall be mutually agreed to between the contractor and the corresponding AAA.

### 2. FACTORY ACCEPTANCE TEST

2.1 The tenderer undertakes to submit for AAA/ICAO's approval at least forty-five (45) days prior to the scheduled commencement of the factory acceptance tests, a Factory Acceptance Test Plan and Procedures. ICAO shall notify the tenderer of its decision within thirty (30) days thereafter, and after an agreement has been reached, the plan/procedures shall form part of the eventual contract. Any changes in the plan/procedures initiated by the tenderer will be without cost to ICAO and subject to ICAO's approval.

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| 2.2 The test procedures shall contain step-by-step instructions with a concise but comprehensive explanation of each test, including test scenario and objective. Test equipment interconnection shall be explicitly described in graphical and textual form as necessary. | |
| 2.3 All test equipment used for the factory tests shall be standard commercial equipment and shall not be modified and all ancillary equipment required for testing shall be furnished by the contractor for the duration of the tests. The successful tenderer shall present the certificates of calibration of the test equipment in accordance with ISO/IEC 17025 or equivalent which will be used to carry out the FAT, installation and maintenance tasks on the supplied equipment. | |
| 2.4 Factory Acceptance shall be required for all equipment, both hardware and software, before shipping. The Factory Acceptance shall verify all the equipment's functional and operational capabilities and physical characteristics as specified in the scope of compliance. | |
| 2.5 All results of the Factory Acceptance Test shall be duly recorded and shall be signed by the tenderer's QA representative and AAA/ICAO representatives. | |
| 2.6 All observations agreed on and discrepancies noted during the Factory Acceptance Test are to be corrected by the tenderer prior to shipment of the equipment. | |
| 2.7 The tenderer shall arrange for one (1) FAT Session, to run consecutively for all equipment and not fragmented sessions. | |
| 2.8 ICAO's appointed representative(s) together with AAA's representative(s) shall be entitled to enter the works of the tenderer at reasonable times during the normal working hours to witness the test of the equipment and work in progress. | |
| 2.9 Notwithstanding any inspection or test conducted at factory prior to shipment, under this Article, all equipment shall be subject to acceptance on site in accordance and to AAA/ICAO's right of rejection. | |
| 2.10 The Factory Acceptance Tests shall be performed at the tenderer's factory in accordance with the approved procedures, the intent of which shall be that those systems tests accepted at factory, as a minimum, shall be functionally duplicated on-site. | |

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| 2.11 The Factory Acceptance Tests shall be conducted in the presence of ICAO's appointed representative and representatives from AAA whose names shall be advised to the tenderer at least three weeks prior to the commencement of tests. Following the satisfactory completion of the tests, ICAO shall sign and issue a Factory Acceptance Certificate. | |
| 2.12 If ICAO's appointed representative does not issue and sign the Factory Acceptance Certificate, he shall immediately notify the tenderer in writing with proper reference to any tests in the approved Acceptance Test schedule or to any part of the Specifications which the equipment has failed to meet. It is agreed between the parties that minor failures, which do not adversely affect the performance or operation of the equipment for the purpose intended and subsequently subject to modification by the tenderer at no extra cost, shall not be considered as items preventing ICAO Factory Acceptance. | |
| 2.13 With respect to ICAO's reason for non-acceptance, the tenderer shall give notice to ICAO stating how it intends to rectify the equipment in order that ICAO may repeat the tests with which the equipment did not initially comply and also the tests in respect of those parts of the equipment affected by the rectification. The tenderer shall bear all costs associated with the re-testing (i.e. travel, accommodation and subsistence costs for ICAO's/AAA's representative(s) re-participation). | |
| 2.14 If the equipment, or any part thereof, is not accepted by the anticipated final Factory Acceptance date for the systems, ICAO shall have the right to request that the accepted component equipment be shipped, provided that the use of the equipment, or any part thereof, for any purpose by AAA/ICAO under such conditions shall not imply Final Acceptance in any way and the tenderer shall be afforded the earliest possible opportunity of taking such steps as may be necessary to obtain Final Acceptance. | |
| 2.15 In the event of ICAO or AAA representatives failing to be present at the time and place appointed by the tenderer for the Factory Acceptance Tests, the tenderer may proceed with the tests which shall be deemed to have been made in the presence of ICAO and AAA representatives and the tenderer shall sign the Factory Acceptance Certificate for corresponding purposes which shall have the same meaning and value as if it had been signed by ICAO. A copy of the FAT test results must be submitted to ICAO for review prior to shipment. | |

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| 2.16 The equipment shall be considered factory accepted by ICAO upon satisfactory completion of each acceptance test as certified by the relevant test records signed by the tenderer's appointed representative and counter-signed by ICAO's appointed representative(s). Three copies of the said records shall be sent to ICAO addressed to the Chief, Field Procurement Section. | |
| 2.17 The tenderer shall ensure that all the equipment included under the eventual Contract, as well as spare parts, tools, test equipment, accessories and documentation are present at the Factory Acceptance, for ICAO inspection, review and approval. | |
| 2.18 The tenderer shall include in his offer, the air travel, accommodation, and DSA costs for the participation at the Factory Acceptance Test by AAA personnel. | |
| 2.19 The tenderer shall identify in the Statement of Compliance each requirement that will be tested during the conduct of the FAT. | |
| **3. TRAINING** | |
| 3.1 **General aspects** | |
| 3.1.1 The Bidder shall include in its proposal a theoretical-practical training programme that will allow the technical maintenance personnel of the AAA to install, operate, maintain, expand, and control the operation of the hardware and software supplied in an efficient manner. | |
| 3.1.2 The training programme shall consist of:<br>a) A theoretical-practical training sub-programme of at least ten (10) working days, to be conducted in a place to be defined, in Spanish, for up to thirty (30) participants.<br>b) A theoretical-practical training sub-programme of at least ten (10) working days, to be conducted in a place to be defined, in English, for up to six (6) participants.<br>c) An on-the-job-training sub-programme at each REDDIG node.<br>d) A theoretical-practical training sub-programme at the manufacturer site for six (6) participants, on network design, configuration and operation, plus integral system maintenance (hardware and software), to be provided by the bidder. | |
| 3.1.3 Upon completion of the training programme, the participants should have *updated* their knowledge of VSAT systems, IP networks, MPLS services, and network management, and *learned* about the technical-operational aspects of the supply regarding the following items: | |

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a) Management the technical documentation of the supply.
b) Supervision of the installation and associated tests.
c) Starting-up the node.
d) Programming, configuration, control, and operation of the NMS system at user and network manager level, as well as its modifications to meet future needs.
e) Identification, diagnosis, location, and troubleshooting of hardware and software at network, system, subsystem, equipment, and module level.
f) Preventive maintenance of hardware y software.
g) Maintenance, modification, and creation of the database.
h) Reporting and statistics.
i) Interpretation of databases and reports.

3.1.4 The training programme shall provide participants with the necessary knowledge for the subsequent levels in the operation and maintenance of the supply:

3.1.5 Basic maintenance level: Includes interventions in the *hardware* and *software* at node, system, subsystem, and equipment level in order to:

a) Operate.
b) Interpret alarms and reports.
c) Reboot systems.
d) Supervise.
e) Identify problems.
f) Clean, replace equipment, fuses, etc.

3.1.6 Intermediate maintenance level: In addition to the preceding level, is includes interventions at *hardware* y *software* level for:

a) Diagnosing and locating failures at module level.
b) Changing modules and printed circuit boards.
c) Conducting measurements through external instruments or instruments built into the equipment.
d) Reloading systems, subsystems, and units with pre-defined configurations.
e) Performing preventive maintenance of the supply.

3.2 **Theoretical-practical training**

3.2.1 Training sub-programmes shall be carried out as follows:

a) Courses shall be taught by professionals of recognised experience, capable of answering any doubt or questions on the hardware and the software that may arise during the classes.

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b) Before starting the courses, the Successful Bidder shall supply all class material to students and instructors.
c) The theoretical part of the courses should be given using multimedia presentations.
d) The practical part of the courses should be given using equipment similar to the ones being offered.
e) The academic week has five (5) days; the academic day has eight (8) effective hours, with lunch and coffee breaks.

3.2.2 The Bidder shall include in its proposal a summary of the proposed training sub-programme, describing the following:

a) The syllabus and content of courses, which should at least cover satellite communications, VSAT systems, REDDIG II architecture, IP networks, route systems, and network management.
b) Timetable, schedule, and duration of each course.
c) Documentation to be provided to students.
d) List of instructors and their background.

3.3 **On-the-job training (OJT)**

3.3.1 The purpose of OJT is for AAA maintenance technical personnel to gain experience and expertise in the supplied systems.

3.3.2 OJT shall be carried out at each REDDIG II node during system installation, equipment and system start-up, interoperation of systems, placement of VSAT antennae, and preliminary tests with the satellite communication service provider.

3.3.3 OJT shall supplement the theoretical-practical sub-programmes, in respect to the radio frequency of the VSAT terminal (tests, measurements, failure analysis, etc.).

3.3.4 On-the-job training (OJT) shall be carried out on site for the technical personnel participating in the installation process, not to exceed five (5) participants.

**4. INSTALLATION**

4.1 **General aspects**

4.1.1 The REDDIG equipment room is where equipment cabinets of the REDDIG node shall be installed and connected to the telecommunications cabling system of the AAA.

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| 4.1.2 The installation, management, cabling, protection, and grounding of the supply shall meet the requirements listed below, and comply with the following standards:<br><br>a) EIA/TIA-606.<br>b) EIA/TIA-607 (*grounding and bonding*).<br>c) EIA/TIA-568-A (*building telecommunications wiring standard*),<br>d) ANSI/EIA-TIA-569 (*building standard for telecommunications pathways and spaces*).<br>e) NFPA/NEC Standard (*National Fire Protection Assoc. /National Electric Code*).<br>f) National regulations in force.<br>g) The recommended practices contained in the Telecommunications Distribution Methods Manual of the *Building Industry Consulting Service International*.<br><br>4.1.3 In case of discrepancies between national laws and the international regulations specified herein, the national laws will prevail.<br><br>4.1.4 Considering that this is a turn-key job, the Bidder shall include in its proposal all the services, equipment, and materials needed to comply with that required in this chapter, especially:<br><br>4.1.4.1 Services<br><br>a) Design<br>b) Installation<br>c) Tests<br><br>4.1.4.2 Equipment and materials:<br><br>a) Cables trays<br>b) Down-leads for antenna and equipment cables<br>c) Clamps<br>d) Anchoring<br>e) Ducts<br>f) Seals for the point of entry of cables into the building<br>g) Cabinets<br>h) Patch panels<br>i) Connecting and crossing panels<br>j) Protectors<br>k) Other accessories and materials needed to lay the lines and cables of power signal and protection circuits. | |

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| 4.1.5 The Bidder, when preparing its proposal, shall take into account the responsibilities of the AAA. The Successful Bidder may use all the services existing at the installation sites only if so advised based on the results of the assessment done during the site survey, and if approved by the project office.<br><br>4.1.6 Cables and cross-connect blocks installed by the Bidder shall be at least of category 5, and shall have cutting and testing capabilities. Cross-connect blocks shall be mounted on racks and/or cabinets. For each node, one (1) set of installation tools, four (4) sets of test cables, and twelve (12) disconnecting plugs shall be provided. Category 5 communication cables shall be certified on site pursuant to TIA standards.<br><br>4.1.7 Land lines for audio, data, trunk lines, aggregate circuits, telephone circuits, control, power, RF, microwaves, etc., shall comply with the following:<br><br>a) Be protected against atmospheric discharges and surges of their own and/or induced by atmospheric discharges on power networks.<br>b) Avoid induction, radiation and/or coupling of interference due to intermodulation, cross interferences, EMI and the radio electric type produced by co-site transmitters, as those that might be produced by transmitters located at other stations.<br><br>4.1.8 The Successful Bidder shall be responsible for the connection of the REDDIG node to the AAA cabling system (*Main Cross Connect – Main distribution frame (MDF)*).<br><br>4.1.9 In general, cables shall use insulating fire retardant covers that do not release toxic vapours. All communication cables shall be AWG-24. Multipair cables must be shielded.<br><br>4.1.10 All physical (copper) lines of communication circuits shall be connected to front and rear access patch panels in the cabinet. These panels shall permit monitoring of circuit operation without interrupting the service, as well as independent testing of equipment and line sides.<br><br>4.1.11 AC equipment shall be fed by uninterrupted power supply (UPS) provided by the AAA. | |

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| 4.1.12 In general, the equipment supplied shall be mounted as follows:<br>a) The equipment shall be contained in closed metal units.<br>b) All in-door mounting elements for systems, subsystems, and equipment shall be supplied and installed in cabinets, except for some equipment that, because of their function and the services they provide, do not require such mounting (*e.g.*, workstations, printers, alarm system sensors, etc.).<br>c) Mountings shall be made to resist seismic activity and flooding in the room where they are located.<br>d) All cabinets and equipment, once placed in their final position, shall be secured.<br>e) All equipment, panels, housings, reference masses, etc. supplied shall be connected to the general grounding system of the station.<br>f) Equipment shall be supplied with the necessary shielding to prevent interference at the installation sites.<br>g) Contact between dissimilar metals that may cause oxidation and interference shall be avoided.<br>h) All surfaces susceptible to corrosion shall be fully protected and treated with anticorrosion processes.<br><br>4.1.13 Basic criteria for the installation of RF lines, antennae, and towers:<br>a) In the case of semi-flexible to rigid lines, extra-flexible and low-loss coaxial cable whips shall be installed at points of interconnection with the equipment and antenna. Likewise, the radii of curvature recommended by the manufacturer shall not be exceeded.<br>b) RF lines shall enter the building through one or more windows opened through its walls or through special ducts already in place. Entrance windows shall be covered with perforated plates that allow the passage of RF lines and microwaves used. Crossing points of these lines shall be protected with rain seals and secured with clamps. Any unused holes on the plate shall be covered with plugs.<br>c) Outdoor connections of the RF physical lines and microwaves shall be weatherproof. External lines shall be laid in raceways and protected against lightning.<br>d) Antennae shall be correctly connected and provided with DC protection directly to the ground.<br>e) Lightning rods (aerial terminals) shall be mounted in the highest part of the tower and the conducting network shall be laid on the outside of the communication tower structure with the use of insulators. In this case, obstruction lights shall be installed. The towers shall be installed in any case to withstand the wind intensity described in the environmental conditions and pursuant to the RS-222D standard. | |

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| 4.1.14 Transmission systems shall have filters and other necessary elements to ensure electromagnetic compatibility and avoid interference that could disrupt the intended communication services as well as those already in existence or foreseen at the installation sites.<br><br>4.1.15 The installation, testing, and supply operations shall not degrade any of the existing services.<br><br>4.1.16 AC feeder cables of the supplied equipment shall end in plugs that are compatible with power outlets of each national standard.<br><br>4.2 **Equipment room**<br><br>4.2.1 REDDIG node cabinets shall be installed in the equipment rooms that already exist at each Air Traffic Control Centre, maintaining the necessary harmony with the equipment and systems already in existence, in terms of cabinets, weights, distances, etc.<br><br>4.2.2 Consideration shall be given to the ease with which the equipment can be serviced, upgraded, expanded, and replaced.<br><br>4.2.3 The Successful Bidder shall also take into account how easy it is to implement future changes in the systems with as little manpower as possible and no service interruptions.<br><br>4.2.4 The work area for the system manager (NMS) shall be provided, including furniture, workstation, and printer, etc. The equipment providing network functions to the NMS shall be installed in the supplied cabinets and shall never be mounted on Manager's furniture. Telecommunication wiring in this area shall correspond to a horizontal cabling system.<br><br>4.2.5 The following free spaces shall be provided for the cabinets:<br><br>a) A space 80-in deep and 2-m high shall be provided for each cabinet, with an 80-cm walkway in front and in the back of the rack or equipment cabinet.<br>b) Cabinets shall not be installed in the corners of the equipment rooms.<br>c) In general, it must assured that all free areas (hallways, corners, work areas, etc.) are measured from the outermost part of racks or cabinets.<br>d) A suitable open space shall be provided for installing at least one additional equipment cabinet. | |

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| 4.3 **Installation methods** | |
| 4.3.1 All equipment shall be mounted on cabinets, except for the NMS workstation and printer. | |
| 4.3.2 Cabinets to be supplied shall be 19 inches, and shall meet the ANSI/EIA-310 standard using the M-6 metric system. Cabinets shall have built-in fans, dust filter, ground bar, power protector and power distributor, and provide access to upper and lower wiring, with removable front, back, and side doors and all the supplementary accessories necessary for proper mounting. | |
| 4.3.3 All cables inside the cabinets shall be arranged inside ducts with removable tops. | |
| 4.3.4 Voice communications ports of the supplied equipment shall be connected with connect and cross-connect blocks. | |
| 4.3.5 Cabinets shall include bantam testing panels for all telephone line threads (tx, rx, and signalling). Panels shall have cutting and testing capability on the side of the line and equipment, and monitoring (parallel). Each node shall be provided with four testing cables. | |
| 4.3.6 Cables in the equipment room shall be laid, as applicable, using elevated cable tray systems (NEC 318), and access systems for raised floor (NEC 645), or built-in raceway or pipelines, if available. | |
| 4.3.7 In general, cable pathways shall comply with the EIA/TIA 569 standard and the standards and recommended practices contained in the Telecommunications Distribution Methods Manual of Building Industry Consulting Service International (BICSI). | |
| 4.3.8 In general, communication cables in raceways shall not be subject to fields greater than 3 volts/metre. | |
| 4.4 **Installation of the dish antenna** | |
| 4.4.1 The installation of the antenna shall be done according to the type of mounting requested for each node. The mounting shall be sufficiently robust and flexible to withstand the wind intensity indicated in this document, and to permit proper aiming towards the satellite. | |
| 4.4.2 The antenna may be installed on the ground or on top of the building; the mounting may be of the penetrating and non-penetrating type. | |

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| 4.4.3 Mounting in the field shall be done on a buried concrete slab with built-in bolts for securing the antenna.<br><br>4.4.4 The mounting on the top of the building shall be done on a concrete slab, with built-in bolts for securing the antenna. If the structure of the building allows it, the whole antenna set may be secured to the structure.<br><br>4.4.5 Outdoor channelling and entry into the building shall be done in accordance with the methods described in the "Telecommunications Distribution Methods Manual" of the BICSI.<br><br>4.5 **Management system**<br><br>4.5.1 The purpose of the telecommunication management system shall facilitate maintenance, change, extension, and movement through the identification of all components of system infrastructure and equipment.<br><br>4.5.2 The management system shall comprise:<br><br>a) The identification of all infrastructure and equipment components through labelling.<br>b) A computerised recording system to record site status, use, and situation of the infrastructure and equipment components.<br>c) An alphanumeric scheme for identifying infrastructure and equipment components.<br><br>4.5.3 Components to be included are spaces, raceways, cables, termination hardware, fields and position for cables, splices, joints and grounding, and the equipment.<br><br>4.5.4 The management system shall meet the EIA/TIA-606 standard requirements. The identification, numbering, and labelling scheme used to identify all telecommunication components and equipment shall be consistent with the "Telecommunications Distribution Methods Manual" of the Building Industry Consulting Service International association. These codes shall be used in the corresponding schemes and computerised recording system of each REDDIG node installation, and be part of the technical documentation to be supplied by the Successful Bidder as specified in this document.<br><br>4.5.5 The EIA/TIA-606 colour code shall be used in the termination hardware for the telecommunication cables in the connection and cross-connection fields. | |

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4.5.6 The colour code shall be used to identify the function of the cable in accordance with the "Telecommunications Distribution Methods Manual".

4.6 **Responsibilities of the AAA**

4.6.1 AAA shall provide an area in a closed environment to be used as the REDDIG equipment room. The space between the floor and the ceiling of the area provided by AAA will be at least 2.6 m.

4.6.2 AAA shall be responsible for providing the following:

a) Room lighting;
b) Fire detection and protection system;
c) False floor and ceiling (optional);
d) Environment control system (air conditioning, humidifiers, heating, etc.);
e) Alternating current (AC) feeder system, backed up and conditioned by UPS (optional) and by power generator;
f) Floor with anti-static coating;
g) Access door of 91 cm wide x 2 m high;
h) Access to the MDF;
i) Secure access to the area; and,
j) Grounded dual power outlets.

**5. SITE ACCEPTANCE TESTS AND START-UP**

5.1 **General aspects**

5.1.1 Supply tests (PS) are aimed at ensuring that the acquired supply meets the specifications detailed in this technical specification document.

5.1.2 The supply tests (PS) are as follows:

a) Factory acceptance tests; (FAT) to be conducted before the dispatch of the goods to the nodes. These acceptance tests will authorize the dispatch of the goods to the nodes;
b) Provisional site acceptance tests (PSATs);
   – Node equipment tests.
   – Networking tests in each node.
c) Provisional network acceptance tests (NATs); and,
d) Final system acceptance tests (FSAT).

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5.1.3 Supply tests (PS) cover the following aspects:

a) Physical inspection of the goods;
b) Physical verification of the installation;
c) Network technical and operational verification;
d) Updates and solution of problems identified during operation.

5.1.4 PSAT tests shall be conducted at equipment, subsystem, system and network level, covering the following aspects:

a) Hardware
b) Software
c) Connectivity to public carrier networks
d) Connectivity to all AAA networks (AFTN, voice channels, data circuits, administrative networks, etc.)
e) NMS
f) Documentation

5.1.5 Provisional network acceptance tests (NATs) shall be performed once the PSAT tests have been completed in all nodes. The purpose of the NAT is to verify that the supply allows the node to establish communication and provide the services requested, and to manage foreseen traffic within the requested performance parameters. It shall also verify the correct operation of the NMS and network stability for a period of no less than five (5) weeks. Based on that specified in this paragraph, the Successful Bidder shall develop its test protocol.

5.1.6 FSAT tests are intended to ensure that the Successful Bidder has resolved all pending issues, even those that might have been identified after the provisional acceptance certificate has been issued.

5.1.7 Supply tests (PS) shall be carried out by the Successful Bidder, with the cooperation of the experts assigned to each node for such purpose and the Project Office. These tests shall be conducted once the Project Office has approved the “Supply Test Protocols” (PPS) documentation.

5.1.8 Supply tests protocols (PPS) and their results may be used by the Project Office as a standard and reference for subsequent tests, and in the operation and maintenance of the supply.

5.1.9 It is expressly established that supply test protocols (PPS) shall be performed in sufficient depth so as to ensure that the tests to be conducted will guarantee and demonstrate that the supply satisfactorily meets all the requirements of the technical specifications document.

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| 5.1.10 The language used for coordination and supply test protocols (PPS) shall be Spanish. If the language normally used by the Successful Bidder is other than Spanish, a set of documents shall be delivered in English.<br><br>5.1.11 The Successful Bidder must provide all the instruments, cables, test connectors, simulators, computers, technical documentation, auxiliary and testing equipment, etc., required for the proper conduction of the aforementioned tests.<br><br>5.1.12 The following is established:<br><br>a) The "provisional acceptance certificate" corresponding to the "provisional network acceptance tests" does not imply the definitive acceptance of the supply.<br>b) Once the "provisional acceptance certificate" has been issued, the Project Office shall request the Successful Bidder to start up the supply.<br>c) The supply warranty shall begin automatically with the aforementioned start-up, and shall be effective for two (2) years.<br>d) The Successful Bidder shall be responsible for the supply until the network starts operating, as certified by the Project Office.<br><br>5.1.13 At the beginning of each supply test (PSAT, NAT, and FSAT), with 15 days in advance, the Successful Bidder shall provide the Project Office with a list of the personnel that will represent it in the tests, and who will be responsible, and sign the protocols, for each supply test. The Project Office will also designate the persons who will represent it during that same period.<br><br>5.2 **Programmes and protocols**<br><br>5.2.1 The supply test programmes (PROG-PS) are documents that establish in detail the timetables, locations, etc. of supply tests.<br><br>5.2.2 The documentation for the supply test programmes shall contain at least the following:<br><br>a) Detailed test timetable, by day<br>b) Test sites and schedules<br>c) List of participants on behalf of the Successful Bidder<br><br>5.2.3 The supply test protocols (PROT-PS) are documents that establish in detail the technical procedures for running the supply tests. The results of these tests must also be recorded in these documents. | |

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| 5.2.4 The documentation of each of the tests established in the supply test protocol shall contain at least the following:<br><br>a) Purpose of the test<br>b) General description of the hardware and software of the supply to be tested.<br>c) Description of test procedures and steps<br>d) Lists with expected results<br>e) Explanatory and interconnection diagrams;<br>f) Detailed listing of the supply to be tested, indicating make, model, and serial numbers;<br>g) Complete technical manuals of the equipment to be tested;<br>h) Operating manual of the specialised instruments and equipment to be used in the test.<br><br>5.2.5 The Successful Bidder shall draft and submit to the Project Office the proposed supply test schedules and protocols for the PSATs, NATs, and FSATs.<br><br>5.2.6 The Successful Bidder shall make available to the Project Office, 60 calendar days in advance, the proposed supply test schedules and protocols for the PSATs, NATs, and FSATs. The Successful Bidder shall take into account the following:<br><br>a) After receiving the proposed supply test schedules and protocols, the Project Office shall have up to 15 calendar days for assessing them and issuing its approval or disapproval.<br>b) If the Project Office considers that the aforementioned proposals do not meet the technical specifications, the proposals of the Successful Bidder shall not be approved. In such case, the Successful Bidder shall correct them by making the additions and/or modifications required by the Project Office and shall submit such documents for approval.<br>c) Any delays in the execution of the contract resulting from the non-approval of the aforementioned proposals shall be attributable to the Successful Bidder and shall not give the right to extensions in the execution timeframes established in the document and in the contract.<br>d) “Supply tests” shall not start until the Contract Office has approved the corresponding testing schedule and protocol.<br><br>5.2.7 Once the Project Office has approved the supply test schedule and protocols, they shall become official documents. | |

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| 5.2.8 During test implementation, the Project Office may include additional testing, as necessary, in order to ensure the correct operation of the supply. These tests shall be automatically included as a supplement to the official test programme. | |
| 5.3 **Start-up** | |
| 5.3.1 The transfer of services from the current AAA systems to the new system shall be the responsibility of the Successful Bidder, and shall be carried out without interrupting the existing services. | |
| 5.3.2 The Successful Bidder shall develop and submit to the consideration of the Project Office the technical procedures for the transfer, including the corresponding diagrams and the resources required. | |
| 5.3.3 The transfer shall be done at the request of the Project, which shall notify the Successful Bidder the date foreseen for the transfer duly in advance. | |
| **6. TECHNICAL ASSISTANCE FOR GROUND BACKBONE** | |
| 6.1 The Successful Bidder shall maintain the quality of the contracted communication circuits throughout the life of the contract, 24 hours a day, 7 days a week (24x7). | |
| 6.2 The Successful Bidder shall provide its main customers with 24x7 access to a Service Desk, with an automated call management centre to control the whole circuit repair process. Maintenance requests addressed to the operators will give rise to the issuance of numbered tickets containing all the information about the failure. | |
| 6.3 The Desk shall operate through a toll-free number (*e.g.*, 0800), providing service in English, Portuguese and Spanish. | |
| 6.4 The service request to the Technical Desk of the successful bidder may be sent, at the discretion of the AAA, *via* e-mail, and the Successful Bidder shall acknowledge receipt of the messages. | |
| 6.5 The Successful Bidder shall notify the AAA of any changes in circuit configuration and repair activities until full normalisation of the service. | |
| 6.6 When corrective maintenance services are provided at AAA units, the Successful Bidder shall coordinate with the AAA the required authorisation and request that specialised professionals designated by the AAA are available while the service is being provided. | |

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| 6.7 Preventive maintenance shall be provided without affecting the operation of AAA systems, and must be notified to the AAA at least ten (10) days in advance by fax or e-mail, and, in all cases, will be subject to AAA authorisation. | |
| 6.8 The MTTA of each location is set in two hours as of the call by the technical team of a REDDIG II node or the REDDIG II administrator, or as of the moment the management system of the Successful Bidder becomes aware of the abnormality, whichever occurs first. In these cases, it is understood that the technical team of the Successful Bidder was not able to successfully conduct the remote maintenance of the equipment installed at the units of the contracting party. | |
| 6.9 The MTTR will be set in two hours and thirty minutes as of the start of the failure in those cases in which the team of the Successful Bidder has to go to the REDDIG II nodes. In the case of remote maintenance, the MTTR shall be thirty minutes as of the time of the failure. | |
| 6.10 In case of non-compliance with the MTTR for a given failure, the Successful Bidder shall immediate notify the AAA the reasons that prevented restoration of service, as well as the steps foreseen to prevent such situation from happening again. | |
| 6.11 The attention finalises when communication circuits are restored to perfect operating conditions, as confirmed by the AAA. | |
| 6.12 At the request of ICAO, the Successful Bidder shall submit, within 48 hours of formalising the request, a report of each attention within a given period, indicating the date and time of the call, the start and end of the attention, the identification of the problem, the measures taken, and other relevant information. | |
| 6.13 The AAA, at any time, may request from the Successful Bidder a detailed report on any event. The Successful Bidder shall send, on a monthly basis, a summary of circuit failures. | |
| 6.14 The technical representative of the Successful Bidder shall sign the report. | |
| 6.15 At the discretion of the AAA, the report may be sent by electronic means or posted on a website. | |

| SECTION E – SERVICES, TESTS AND ACCEPTANCE | |
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| 6.16 The Successful Bidder shall provide ICAO, at the beginning of the contract, the list, in hierarchical order, of those responsible for maintenance activities, who, at the discretion of ICAO, may be requested to provide further clarification. This list shall indicate, on the top, the name of the director responsible for the operation of the regional network of the Successful Bidder. | |
| **7. GUARANTEES** | |
| **7.1 Technical guarantee of the supply** | |
| 7.1.1 The successful bidder shall warrant that all equipment delivered under an eventual contract (including any equipment components manufactured by their sub-contractors) shall perform in accordance with and conform to all specifications, descriptions, and other requirements included in their offer and shall be without defects in materials, workmanship, and design. Failing to accomplish these performance criteria, the successful bidder must modify/add and/or exchange the inadequate equipment and/or software, if necessary, to provide the specified functions. | |
| 7.1.2 The successful bidder warranty shall remain in effect for a period of two (2) years from the final commissioning date to the levels and figures achieved and approved at the time of the Factory Acceptance Test and Provisional Site Acceptance Test. With respect to major systems and/or equipment repaired pursuant to this article the original period of the warranty of the said equipment shall be extended for a warranty period equivalent to the time required for the repair. | |
| 7.1.3 The successful bidder shall be responsible for processing all under warranty claims and will cover all expenses involved in transportation, customs clearance, shipment, and installation of the defective equipment to and from the sites. | |
| 7.1.4 The warranty period shall begin anew for any equipment replaced pursuant to this article. | |
| 7.1.5 The successful bidder shall submit to ICAO/AAA a copy of formal agreement(s) with local appointed companies responsible for any warranty service. | |

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| 7.1.6 If any equipment fails during the warranty period, before its expiration, AAA shall immediately inform the successful bidder, specifying the failure where possible. The successful bidder shall decide whether to repair the item locally or return it to their facilities for repair. If a spare part(s) or replacement item is not available to restore equipment operation, the successful bidder, shall provide an immediate replacement of the failed item(s) in order to restore immediate operational capability at no extra cost. The successful bidder shall guarantee a 30 day turnaround time to replace all failed item(s) (excluding shipping and customs clearance time).<br><br>7.1.7 If the reported problem is not solved in thirty (30) days, each AAA shall be entitled, at their option, to:<br><br>• return the equipment and require the successful bidder to repair and make re-delivery, or<br><br>• repair the equipment or have the equipment repaired by a third party and, in either case, recover the reasonable cost of repair from the successful bidder, or<br><br>• require the successful bidder to deliver replacement equipment.<br><br>7.1.8 With respect to the provisions of this Article, the return and re-delivery of the equipment, as well as the repair, shall be at the successful bidder's risk and expense. AAA shall also be entitled to recover from the successful bidder all reasonable and demonstrable costs incurred in removing the equipment or assembly and in re-installing repaired or replacement equipment. It is understood that such warranty repair work will be carried out in-factory, or locally at the appointed representative's facilities, except in the case of a system failure which might require dispatch of successful bidder's engineers to the sites.<br><br>7.1.9 If it is determined that the equipment sent to the successful bidder under this Article was not defective according to the above article, the transportation cost from the site to the factory and return shall be covered by the corresponding AAA.<br><br>7.1.10 Approval or acceptance of the successful bidder's designs or acceptance of the equipment shall not prejudice ICAO/AAA rights under this Article.<br><br>7.1.11 The rights under this Article shall be enforceable by each AAA and ICAO respectively. | |

| SECTION E – SERVICES, TESTS AND ACCEPTANCE | |
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| 7.1.12 ICAO's and AAA's rights under this Article are not exclusive and any other rights provided in this Contract or by Law are reserved. | |
| 7.1.13 This warranty does not apply for normal wear and tear items. It shall not cover equipment or parts of equipment modified after its delivery without the successful bidder's prior written agreement. | |
| 7.1.14 Within the warranty period, the successful bidder confirms an unlimited number of on-site visits and maintenance assistance, on an on-call basis for warranty claims at no cost to each AAA, should the problem solution fail via remote facilities. | |
| 7.1.15 The use of a Local Representative by the successful bidder shall not diminish the successful bidder's responsibilities and obligations under an eventual Contract. Any upgrading and modification of the equipment associated with the defaults of the equipment shall be provided by the successful bidder at no extra cost to each AAA within the expected period of the system operation. | |
| 7.1.16 If the operation or use of the materials or equipment proves to be non-compliant with the technical specifications or intended performance characteristics, ICAO/AAA shall have the right to operate and use such material or equipment until they can be taken out of service for correction by the successful bidder of such defects, errors, or omissions and for replacement in whole or in part if correction is unsuccessful or unfeasible. | |
| 7.1.17 During the Warranty Period, if any equipment or equipment component part fails that is not included in the list of spare parts recommended by the successful bidder, the successful bidder shall supply said part or component at no additional cost to the corresponding AAA, as a spare part. | |
| 7.1.18 The warranty period shall commence after the equipment has been received on site, site tested, commissioned and accepted by ICAO/AAA after the FSAT and free from any faults or defects, both operational and functional. | |
| 7.1.19 In order to facilitate compliance with the preceding paragraphs, the Successful Bidder will have access to the supplied spare parts, ensuring a round-trip time of 30 days (excluding shipping and customs clearance) to replace all failed items. | |

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| 7.1.20 The Successful Bidder shall return the item(s) to the factory for repair. If the spare part is not available for returning the equipment to operating conditions, the Successful Bidder shall provide, at no additional cost, an immediate replacement of the failed items in order to restore the operational capacity of the failed equipment.<br><br>**7.2 Spare parts guarantee**<br><br>7.2.1 The Bidder shall ensure, through a document signed by its legal representative, the supply of all the required spare parts, as well as of technical support services for the entire supply for a period of no less than the useful life of the equipment, which should not be less than seven (7) years. | |

## GLOSSARY OF ACRONYMS

For purposes of this document, the following acronyms will apply:

| | | |
|---|---|---|
| AAA | Autoridad de Aviación Civil | Civil Aviation Authority |
| AFS | Servicio Fijo Aeronáutico | Aeronautical Fixed Service |
| AMHS | Sistema de Manejo de Mensajes Aeronáuticos | ATS Message Handling System |
| ANSI | | American National Standards Institute |
| ATN | Red de Telecomunicaciones Aeronáuticas | Aeronautical Telecommunication Network |
| BER | Tasa de Error de Bit | Bit Error Rate |
| COTS | | Commercial Off-The-Shelf |
| ECMA | | European Computer Manufacturers Association |
| EIA | | Electronic Industries Alliance |
| ET | Equipo Terminal | Terminal equipment |
| ETSI | | European Telecommunication Standards Institute |
| FAT | | Factory Acceptance Test |
| FIR | Región de Información de Vuelo | Flight Information Region |
| IEC | | International Electrotechnical Commission |
| IETF | | Internet Engineering Task Force |
| ISO | Organización Internacional de Estandarización | International Organization for Standardization |
| ITU | Unión Internacional de Telecomunicaciones | International Telecommunication Unit |
| LAN | Red de Area Local | Local Area Network |
| MoU | Memorandum de Entendimiento | Memorandum of Understanding |
| MPLS | | Multiprotocol Label Switching |
| NEC | | National Electrical Code |
| NFPA | | National Fire Protection Association |
| OACI | Organización de Aviación Civil Internacional | International Civil Aviation Organization |
| OSI | Interconexión de Sistemas Abiertos | Open System Interconnection |
| OJT | Entrenamiento en el Trabajo | On-the-Job Training |

| | | |
|---|---|---|
| PP | Punto de Presencia | Presence Point |
| PST | Proveedor de Servicios de Telecomunicaciones | |
| QoS | Calidad de servicio | Quality of Service |
| RFC | | Request for Comments |
| RTCA | | Radio Technical Commission for Aeronautics |
| SLA | Acuerdo de Nivel de Servicios | Service Level Agreement |
| SAT | Prueba de Aceptación en el Sitio | Site Acceptance test |
| SDD | Documento de Diseño del Sistema | System Design Document |
| TIA | Asociación Industrial de Telecomunicaciones | Telecommunication Industry Association |
| VPN | Red Privada Virtual | Virtual Private Network |
| VSAT | | Very Small Aperture Terminal |
| UPS | Fuente de Potencia no Interrumpible | Uninterruptible Power Supply |
| WAN | Red de Area Extensa | Wide Area Network |

## DEFINITIONS

For purposes of this document, the following definitions will apply:

Bandwidth: Maximum packet speed from a dedicated connection port, expressed in Kbit/s or Mbit/s.

REDDIG II applications: Services to be provided by REDDIG II, as defined in the body of the document.

Physical layer (Level 1): The physical layer defines the technical characteristics of the electrical and optical (physical) devices of the system. It contains the cabling or other communication channels that communicate directly with the network interface controller. Therefore, it provides simple and reliable communications, in most cases with basic error control:

It moves bits (or bytes, depending on the transmission unit) through a transmission medium.
It defines the electrical and mechanical characteristics of the medium, the bit transfer rate, voltage, etc.
It executes and controls data transmission volume and speed on the network.

It is not the function of the physical layer to take care of issues such as transmission errors, which are taken care of by the other layers of the OSI model.

Network layer (Level 3): The network layer is responsible for network addressing of packets, also known as datagrams, relating logical addresses (IP) to physical addresses so that network packets can duly get to their destination. This layer also determines the route that packets will follow to get to their destination, based on factors such as network traffic and priorities.

This layer is used when the network has more than one segment and thus data packets will have more than one pathway to follow from origin to destination.
Functions of the layer:

Move packets from origin to destination through one or more links.
It defines how network devices identify each other and how packets are routed to their final destination.

Circuit: Communication link intended for carrying AAA applications, including the interconnection between the general distributor (DG) or the equipment of the Contracting Party and the ET of the Successful Bidder.

Access circuit: Dedicated MPLS connection circuit between the PPs and the sites of the Successful Bidder.
Router: equipment capable of IP processing that determines the routes through which packets shall be routed.

Contracting Party: ICAO, on behalf of the States (AAAs) of the Region. In terms of activities related to equipment maintenance, configuration and any other services required, the Contracting Party is understood to be the technical teams of all the nodes involved in REDDIG II (AAA).

Successful Bidder: The company that wins the bidding process and that will supply, install and condition the equipment for the satellite network, and that will provide the telecommunication services for the ground network on its own or through a subcontractor (PST).

Availability: A parameter for measuring performance, which consists of the percentage of time that the PP/node (as applicable) is operational in a given period of time during which the service is being provided.

ETA (*Estimated Time of Arrival*): The time at which the Successful Bidder estimates that one of its technicians will arrive at the location following the notification from the Contracting Party.

Bidder: A company that participates in the bidding process.

MTBF: Mean time between failures.

MTBCF: Mean time between critical failures.

MTTA (*Maximum Time To Arrive*): Maximum time that the technician will take to arrive at the location indicated by the Contracting Party as a result of partial or total failure of the service provided.

MTTR (*Maximum Time To Restore)*: Maximum time for restoring the service.

Project office: ICAO staff responsible for coordination before and after the bidding process, until the final implementation of the network (FSAT).

Packet: Minimum amount of information capable of being processed by a router.

Packet loss: Parameter for measuring the performance of the network of the Successful Bidder, which consists of the rate of success in the transmission of packets originating in the network of the Contracting Party.

Port: Point of entry to the equipment of the Successful Bidder ground network that has a dedicated bandwidth for the network of the Contracting Party.

Network of REDDIG II member States: Set of interconnected equipment, cables and software that belongs to those represented by the Contracting Party.

Network of the Successful Bidder: Set of interconnected equipment, cables and software that belongs to the Successful Bidder, configured so as to duly support the provision of the service.

Latency: A parameter for measuring service performance that consists of the mean transit time of a 64-byte packet between two PPs of the Contracting Party.

Delay: In this document, it is understood to be the feature inherent to statistical and deterministic networks that consists of end-to-end propagation time of applications.

RTT (*Round Trip Time*): Round-trip delay in the communication of a 64-byte packet between any two PPs.

Data security: For purposes of this bidding process, data security is understood to be the protection against unauthorised access to the communication circuits and devices of the Successful Bidder. The inclusion of cryptography in communication circuits by the Successful Bidder is not part of this process.

Contracted service- REDDIG II ground MPLS backbone (or simply MPLS service): Consists in providing the Contracting Party with the functionalities required in this technical specifications document, as a way of interconnecting the applications of interests of REDDIG II *via* a ground medium. Thus, it shall have full traffic capability for the applications identified in this document, including corporate telecommunication services – voice and/or data and/or videoconferencing.

Satellite service - REDDIG II satellite backbone: The current structure of REDDIG involves hiring a space segment and its management and control by the REDDIG management. Thus, the management structure of the current REDDIG shall be maintained, through the acquisition of the ground station infrastructure with the associated spare parts.

Monthly cost: Value to be paid by the Contracting Party to the Successful Bidder for the monthly provision of the MPLS ground service.

## APPENDIX B

## ACTION PLAN FOR THE IMPLEMENTATION OF A NEW DIGITAL NETWORK FOR THE SAM REGION (SAM ATN NETWORK)

| ACTIVITIES | ACTION TO BE TAKEN BY | DELIVERABLE | TARGET DATE | REMARKS |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| **1** Identify current voice and data services requirements, as well as those scheduled to be implemented in the short, medium and long term in the Region, in support of air navigation | SAM/IG Group for the implementation of CNS improvements | List of services requirements in support of air navigation for the Region, including those scheduled for the short, medium and long term | SAM/IG/6 | **Completed** Identified in the study for the implementation of the new digital network, REDDIG II |
| **2** Analysis of band width required for the services identified in Activity 1 | SAM/IG Group for the implementation of CNS improvements | Amount of band width required to support the requirements specified in Activity 1 | SAM/IG/6 | **Completed** Identified in the study for the implementation of the new digital network, REDDIG II |
| **3** Determination of costs for the band width increase in REDDIG | SAM/IG Group for the implementation of CNS improvements | Implementation costs of new REDDIG services | SAM/IG/6 | **Completed** Identified in the study for the implementation of the new digital network, REDDIG II |
| **4** Study of the new REDDIG technological platform and determination of its cost | SAM/IG Group for the implementation of CNS improvements | Definition of the REDDIG technological platform | SAM/IG/6 | **Completed** Identified in the study for the implementation of the new digital network, REDDIG II |
| **5** Study of a ground regional IP structure supporting the services required and defined in Activity 1, as well as of the band width requirements defined in Activity 2 | SAM/IG Group for the implementation of CNS improvements | Definition of a regional ground IP network model structure | SAM/IG/6 | **Completed** Identified in the study for the implementation of the new digital network, REDDIG II |

| ACTIVITIES | ACTION TO BE TAKEN BY | DELIVERABLE | TARGET DATE | REMARKS |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| **6** Determination of costs for the implementation of Activity 5 | SAM/IG Group for the implementation of CNS improvements | Implementation costs of a digital ground IP network structure | SAM/IG/6 | **Completed** Cost estimates were identified in the study for the implementation of the new REDDIG II regional digital network and consulted with some communications service providers |
| **7** Study on the structure of a mixed (ground and satellite) regional digital network structure | SAM/IG Group for the implementation of CNS improvements | Model definition | SAM/IG/6 | **Completed** Identified in the study for the implementation of the new digital network, REDDIG II |
| **8** Determination of the costs for the implementation of Activity 7 | SAM/IG Group for the implementation of CNS improvements | Implementation costs of a mixed (ground and satellite) digital network structure | SAM/IG/6 | **Completed** Cost estimates were identified in the study for the implementation of the new REDDIG II digital network and consulted with the industry (manufacturers, integrators and communications service providers) |
| **9** Comparisons between the network infrastructure models specified in Activities 4, 5 and 7 | SAM/IG Group for the implementation of CNS improvements | Comparative study between the ground IP and mixed (satellite and ground) satellite network models | SAM/IG/6 | **Completed** Identified in the study for the implementation of the new digital network, REDDIG II |
| **10** Determination of the regional network infrastructure model, on the basis of results of Activity 9 | SAM/IG Group for the implementation of CNS improvements | Final review to the study of the new digital network, REDDIG II | REDDIG RCC/14 meeting (Lima, Peru, 16-18 Mar 2011)<br><br>SAM/IG/7 | **Completed** The study for the new SAM digital network was distributed to all REDDIG member States and Panama for comments. Replies were received from Argentina, Brazil, Chile and Panama. REDDIG RCC/14 meeting (Lima, Peru, 16-18 March 2011) examined and approved the infrastructure model formulated in the study. In addition, SAM/IG/7 meeting endorsed RCC/14 meeting's approval. |
| **11** Holding of a seminar/workshop on new satellite and ground networks technology | Secretariat | Technological solutions for the new REDDIG II regional network configuration | Lima, Peru, 18-20 July 2011 | **Completed** During this seminar/workshop, the communications services providers, integrators and manufacturers will present initial implementation proposals on the new REDDIG II digital network |

| ACTIVITIES | ACTION TO BE TAKEN BY | DELIVERABLE | TARGET DATE | REMARKS |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| **12** Acceptance process for the implementation of the network infrastructure model determined by Activity 10, through a public bidding process | SAM/IG Group for the implementation of CNS improvements | Acceptance of the public bidding process for the implementation of a SAM network infrastructure | REDDIG RCC/14 meeting (Lima, Peru, 16-18 Mar 2011)<br><br>SAM/IG/7 | **Completed** REDDIG RCC/14 meeting examined and approved the infrastructure model formulated in the study. In addition, SAM/IG/7 meeting endorsed RCC/14 meeting's approval. |
| **13** Preparation of technical specifications for the implementation of the SAM network infrastructure specified in Activity 10 | SAM/IG Group for the implementation of CNS improvements | Technical specifications for the implementation of a SAM network infrastructure | Aug 2011 | **Completed** The technical specifications were drafted with the support of RLA/06/901 |
| **14** Circulation to States of the technical specifications for the implementation of the SAM network infrastructure | Secretariat | Approval of technical specifications for the implementation of the SAM network infrastructure | Sep 2011 | **Completed** Circulated to all REDDIG members for comments |
| **15** Presentation of REDDIG network study and technical specifications to RAAC/12 meeting | Secretariat | Go ahead for the public bidding process through ICAO | Oct 2011 | **Completed** The Twelfth Meeting of the Civil Aviation Authorities of the SAM Region (RAAC/12) approved starting the bidding process for the implementation of REDDIG II, through the formulation of Conclusion RAAC/12-6 |
| **16** Review of technical specifications on the basis of comments from States, and submittance to ICAO HQ TCB to start the bidding process | REDDIG Administration | REDDIG technical specifications | Jan 2011 | **Completed** Final technical specifications were sent to TCP (Purchasing Section) to start with bidding process |
| **17** Drafting of assessment criteria of REDDIG II offers | REDDIG Administration and ICAO Technical cooperation Directorate | Offers assessment criteria | Jan 2011 | **Completed** The criteria for the offer assessment will be used |

| ACTIVITIES | ACTION TO BE TAKEN BY | DELIVERABLE | TARGET DATE | REMARKS |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| **18** International bidding process for REDDIG II implementation | ICAO Technical Cooperation Bureau | Bidding process | Apr 2012 | **Completed** Bidding process started on 4 April 2012. The calling for bidding was uploaded in the site www.lima.icao.int/procurement, under number 22501200 |
| **19** Reception of offers | Bidding companies | Offers from bidders | 1 Jun 2012 | **In course** Offers target delivery date is 1 June 2012 |
| **20** Evaluation of offers presented to determine winning company | REDDIG experts members and Administration | Assessment of offers | 4-8 Jun 2012 | **To be conducted** The REDDIG experts members will be composed by specialists from Argentina, Bolivia, Brazil, Colombia, French Guiana (France, Peru and Venezuela. In addition, REDDIG Administration will participate (ICAO SAM Secretariat and REDDIG Administrator) |
| **21** Bid winner negotiation process | ICAO Technical Cooperation Bureau and REDDIG Administration | Negotiation with bid winner | 11-15 Jun 2012 | **To be conducted** Negotiation with bid winner to determine the better value |
| **22** Review and approval of offer evaluation analysis and approval of winning company | REDDIG RCC/15 meeting | Considerations to and approval of offers assessment and of selected bid winner | 25-27 Jun 2012 | **To be conducted** All REDDIG members unable to participate in the assessment process will have the opportunity of considering and approving the assessment and selection of the winning company |
| **23** Start of REDDIG II installation | Bid winner | REDDIG II installation | Mar 2013 | **To be conducted** It is expected that by the first quarter of 2012, all REDDIG members have cancelled the quotas corresponding to the implementation of REDDIG II |
| **24** REDDIG II Supervision and installation | REDDIG Administration and member States | REDDIG II supervision and installation | Mar-Sep 2013 | **To be conducted** REDDIG member States, together with its Administration, will supervise all REDDIG II installation works |
| **25** REDDIG II acceptance trials | REDDIG Administration, member States and winning company | REDDIG II acceptance | Sep-Nov 2013 | **To be conducted** REDDIG member States, together with its Administration, will conduct the REDDIG II acceptance trials |
| **26** REDDIG II operation | Winning company | REDDIG II operation | Dec 2013 | **To be conducted** All services in operation through REDDIG II |