INTERNATIONAL CIVIL AVIATION ORGANIZATION

SECOND MEETING OF THE APIRG COMMUNICATIONS, NAVIGATION AND SURVEILLANCE SUB-GROUP (CNS/SG/2)

(Dakar, 22-25 May 2007)

Agenda Item 4: Aeronautical Fixed Services

Guidelines for the performance of VSAT networks

(Presented by the Secretariat)

SUMMARY

This paper provides some guidelines on performance of VSAT networks being planned/implemented in the AFI Region for consideration by the CNS Sub-group.

Action by the meeting is at paragraph 3.

References :

- APIRG/15 – Report.
- ALLPIRG/5 – Report.

1. Introduction

1.1 ICAO (Headquarters and Regional Offices) has been working closely on the harmnization of implementation activities relating to the use of VSAT networks.

2. Discussion

2.1 As part of the aforementioned work and following Conclusion 5/17 of the ALLPIRG/5 Meeting, some guidelines on performance of VSAT networks have been prepared to establish a basis for planning and basic system design of such networks in support of aeronautical ground-ground communications. These guidelines are attached hereto (See **Attachment**).

2.2 Currently, the possibility of extending the notion of required communication performance (RCP) to ground-ground communications is being investigated. If proved feasible, the provisions to be developed will further facilitate the implementation of the aeronautical communications infrastructure on the required end-to-end performance.

3. Conclusion

3.1 The CNS Sub-group is invited to :

a) note the information contained in Attachment to this paper ; and
b) make use of the guidelines therein when addressing VSAT planning and implementation issues.

ATTACHMENT

Guidelines on Performance of VSAT Networks

1. **Introduction**

1.1 Digital communication networks based on very small aperture terminal (VSAT) are being increasingly used in the provision of aeronautical ground-ground communications in areas where terrestrial communication systems are unavailable, unreliable or uneconomical. VSAT networks are generally flexible, scalable, versatile, easy to implement/operate and cost-effective in certain areas, terrains or conditions.

1.2 On the other hand, a wide variety of often incompatible architectures, configurations, access techniques, management, operation schemes and protocols are used in different VSAT networks. Moreover, almost all VSAT networks available in the market employ some proprietary products. As a result, in general, non-identical VSAT networks are not interoperable.

1.3 There are no international standards specifically governing VSAT networks. A number of International Telecommunication Union (ITU) Recommendations relating to radio frequency or other aspects of communication systems are applicable to VSATs and are often complied with by VSAT vendors. Such compliance should not, however, be interpreted as an indication of compatibility with other products.

1.4 ICAO has not standardized the physical layer of communications, therefore there are no provisions for VSATs, nor for terrestrial-based systems-like cable, microwave relay system or optical fibre.

1.5 Noting the above, States or organizations that plan to implement VSAT networks for the provisions of aeronautical ground-ground communications, are advised to:

a) ascertain that VSAT is in fact the preferred and most cost-effective means of communications in the geographical area (s) of interest;

b) take into consideration Conclusion 5/16 of ALLPIRG/5; and

c) use the performance requirements stated in the ensuing paragraph as a guide to planning, system design and evaluation activities.

2. **Performance requirements**

2.1 Many factors influence the architecture, configuration and system design of a VSAT network. The end user is however mainly interested in the quality or performance of the communication service that is being provided and not so much in the technical details. As such, the user should state the desired basic performance requirements at the very early stage of planning to enable VSAT system design to proceed accordingly. Such performance requirements, once agreed upon by all parties concerned, would be used as a basis for further evaluation and continuing monitoring of the network.

2.2 In general, there is a direct relationship between performance and cost. This is particularly important for VSAT networks as there are also many parameters involved in achieving a given performance level. For example, insisting on higher availability implies duplicate terminals using different satellites. Similarly, a very low bit error rate requires large earth station antennas, high power transmitters and large satellite transponder bandwidth. All those directly translate to significantly higher acquisition and operation costs.

2.3 The minimum performance targets stated below are generally suitable for aeronautical ground-ground communication and can be achieved with "reasonable" resources and cost. The stated performance parameters apply to the overall communication service as seen by the end user of a digital VSAT network.

Availability >= 99.8%
(See Note 1)

Bit error rate (BER)<= 1 in 10^{7}
(See Note 2)

One-way latency (for voice communications)< 400 ms
(See Note 3)

Call blocking probability <= 2.5×10^{-3} (or 1 in 400 attempts)
(See Note 4)

Call set-up time <= 2 s

Note 1. The above shows the required overall availability of the communication service to the end user. It includes the consideration of all scheduled/non-scheduled maintenance and sun outages.

Note 2. BER is applicable to the physical layer of communications. Forward error correction (FEC) may be employed to achieve this figure.

Note 3. The above implies that for voice communications, only a single satellite hop should be used. The major contributor to the latency is the propagation delay of approximately 240 ms (a single hop). Voice compression and encoding also introduce additional delays.

Note 4. The above applies to a normal switched voice communications environment. In certain operational scenarios, it may be necessary to guarantee the availability of a voice circuit upon demand by employing priority/pre-emption techniques or dedicated satellite resources.

----------END----------