International Civil Aviation Organization

ALLPIRG/5-WP/13
15/02/06

WORKING PAPER

FIFTH MEETING OF THE ALLPIRG/ADVISORY GROUP

(Montreal, 23 – 24 March 2006)

Agenda Item 5.3: Coordination between the regions and between the Regional Offices and Headquarters

THE USE OF VERY SMALL APERTURE TERMINAL (VSAT) NETWORKS FOR AERONAUTICAL COMMUNICATIONS

(Presented by the Secretariat)

SUMMARY

The use of very small aperture terminal (VSAT) technology in the provision of aeronautical communications has long been the subject of discussion in some ICAO Regions. In general, the number of such networks has been increasing and, as a result, their interconnections and seamless operations have become a matter of concern. This paper discusses the subject and suggests ways of achieving seamless communications.

Action by ALLPIRG/5 is in paragraph 4.

1. INTRODUCTION

1.1 This paper provides an overview of the issues associated with the implementation, operation and evolution of the VSAT networks that support the provision of the aeronautical fixed service (AFS) and other ground-ground communications. This paper also presents the background to the VSAT question in the context of aviation, discusses problems associated with the proliferation of VSAT networks, and makes recommendations to avoid or minimize such problems in the future.

1.2 One-way (receive only) VSAT terminals that are being used throughout the world for reception of world area forecast system (WAFS) products and operational meteorological (OPMET) data are not discussed in this paper.

2. BACKGROUND

2.1 Traditionally, facilities that support AFS, namely the aeronautical fixed telecommunication network (AFTN) and air traffic services (ATS) voice communications networks have been implemented through the use of dedicated circuits leased from telecommunication service providers. Where air navigation service providers leases such circuits, they are not generally concerned about how the circuits have been established. Instead, they demand high availability and an acceptable level of performance that are needed to support aeronautical communications.

2.2 In certain ICAO Regions, it has been observed that the leased circuits lack the necessary availability, reliability and performance. As such, dedicated national, subregional or regional communication networks have been implemented to provide platforms for the AFS and other operational aeronautical communications (e.g. transfer of radar data). A variety of communication media, such as microwave radio, cable, optical fibre or VSAT have been used in the implementation of those networks.

2.3 Due to its inherent flexibility, cost-effectiveness and ease of implementation, VSAT technology has been the most popular choice for providing a communication platform for aviation in the Africa/Indian Ocean (AFI) and Caribbean/South America (CAR/SAM) Regions. In fact, since the late 1980s, almost all regional air navigation and planning and implementation regional group (PIRG) meetings in those Regions (and recently in the Middle East (MID) Region as well) have developed recommendations, conclusions and decisions pertaining to VSATs and their interconnections with other networks (like the Eastern-Caribbean (E-CAR) network in the CAR Region, which is based on optical fibre).

2.4 The problems associated with the growing number of networks and their interconnections are briefly discussed in the ensuing paragraphs.

3. DISCUSSION

3.1 The choice of medium (e.g. terrestrial or satellite) for the provision of the AFS has never been the subject of standardization by ICAO. For example, Standards and Recommended Practices (SARPs) for the AFTN cover only addressing, routing, message formats and associated protocols and procedures and the choice of the physical circuit is left to States/regions that in turn either lease or implement them.

3.2 Those States/regions, choosing to implement their own communication networks, consider availability, cost, ease of maintenance and other local or individual constraints in their choice of system. In such cases, the interconnection between two digital networks is a local matter that involves recovery of the bit streams from one and reformatting them for transmission over the other. In this regard, it would be fair to say that it is not practical for the Organization to develop provisions covering all possible types of physical and protocol interfaces. However, certain performance-based provisions could be developed to govern the end-to-end requirements and to narrow the choices for the technologies employed.

3.3 Interconnection between two VSAT networks is, in general, more complex especially if the networks use different satellites, access schemes and protocols. Even if the two networks are identical (using the same satellite and transponder while remaining separate in terms of addresses and control), their interconnection involves:

a) an extra satellite hop (adversely affecting voice communications due to the additional propagation delay of 250 ms);

b) duplicate network operations and control centres/contracts;

c) duplicate satellite transponder leases (often with unused capacities); and

d) duplicate planning and administrative efforts.

3.4 A list of existing and planned national, regional and interregional VSAT networks dedicated to aeronautical communications in AFI, CAR/SAM and MID is provided in the Appendix attached hereto. The list shows a continuing trend to implement VSAT networks even when one or more of the existing ones can easily be expanded to serve the area of interest. In this regard, recent efforts in AFI/MID and CAR/SAM Regions to utilize the same satellite and identical technology as much as possible to facilitate the interconnections should be acknowledged.

3.5 In general, interconnection of VSAT networks increases complexity/cost and degrades the overall performance (especially for voice communications). Ideally, where there is proper coverage and capacity available by one satellite, efforts should be made to implement a single VSAT network. Unfortunately, in practice, this principle has not always been followed mainly on non-technical grounds, and a multitude of VSAT networks with varying access and network protocol schemes have already been implemented. As such, the only practical way forward is to use any opportunity for equipment upgrade or renewal in any given region to integrate various neighbouring VSAT networks into single one.

3.6 Even a truly regional VSAT (or terrestrial) network has to be interconnected with other regional ones to support international aeronautical communications. In this context, the choice of network protocol is of utmost importance in order to avoid cumbersome routing and addressing conversion schemes. A plethora of older and newer network protocols are being offered by vendors and it would be of utmost importance to select the type that is easiest to implement, least costly to operate and easiest to interoperate with other networks (including the Internet).

3.7 It is the view of the Secretariat that Internet Protocol- (IP) based networks may provide an optimum means of establishing regional/interregional aviation intranets that would also enable access by users to vast resources available on the Internet (e.g. aeronautical meteorology and other databases).

3.8 Another point to consider is the need to exploit the potential that modern technology offers. For example, often a modern communication system is being used to establish low-speed AFTN connections that are not capable of supporting emerging operational requirements. Also, the exchange of OPMET data by table-driven codes that will be phased in through amendments to Annex 3 — *Meteorological Service for International Air Navigation* between 2007 and 2016 cannot be accomplished by AFTN protocols. This is another reason to consider the use of the Internet Protocol Suite (IPS) where it is cost-beneficial to do so.

3.9 Work has already started in the Organization to develop provisions relating to the use of the IP, Internet and related protocols. A manual entitled "*Guidelines on the Use of the Public Internet for Aeronautical Applications* (Doc 9855)"has already been published. Proposed amendments to Annex 3 and Annex 15 — *Aeronautical Information Services* are currently being developed to enable the use of the Internet for certain operational communications. As to the use of the IPS in the aviation infrastructure, the Aeronautical Communications Panel (ACP) is currently investigating the subject (including its associated security aspects) with the aim of developing the necessary provisions by June 2007. In this regard, it

should be noted that provisions have already been developed for the use an IP network as a subnetwork of the aeronautical telecommunication network (ATN).

3.10 Information security and the need to provide adequate protection against possible security threats should always be included in any aeronautical communication planning activity. In this context, it is noteworthy that, in most parts of the world, it is already possible to obtain a secure IP-based virtual private network (VPN) for aeronautical applications from commercial communication service providers. Therefore, where available and cost-effective, the alternative of leasing a VPN should be duly considered. Again, a universally agreed set of end-to-end performance requirements would greatly facilitate the formulation and administration of contracts for obtaining such services.

3.11 In summary, it is evident that IP is the most widely used method of networking that provides global connectivity in the most economical manner. Moreover, all indications are that IP (in the form of IP Version 6 with its enhanced security features) will continue to be the dominant technology for networking in the foreseeable future.

4. ACTION BY ALLPIRG

4.1 The ALLPIRG/5 Meeting is invited to:

a) note the information provided in this working paper on VSATs

b) adopt the following conclusions:

Draft Conclusion 5/x – Implementation of very small aperture terminals (VSATs)

That PIRGs:

a) discourage the proliferation of VSAT networks where one/some of the existing ones can be expanded to serve the new areas of interest;

b) work towards integrated regional/interregional digital communication networks with a single (centralized) operational control and preferably based on the Internet Protocol (IP); and

c) give due consideration to managed network services (e.g. a virtual private network (VPN)) subject to availability and cost-effectiveness.

Draft Conclusion 5/x – Provisions for digital communication networks

That ICAO:

a) expedite the development of provisions relating to the use of the Internet Protocol Suite (IPS) in the aeronautical telecommunication infrastructure; and

b) initiate the development of provisions governing the end-to-end performance of digital communication networks irrespective of the technologies and protocols utilized therein.

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APPENDIX

Summary of VSAT networks in AFI, MID, CAR and SAM Regions

Region	Designation	States/Area served	Satellite used	Topology	Access technique	Year of completion	Remarks
AFI	AFISNET	26 States (mainly in Western and Central Africa)	Intelsat 10-02	Mesh	FDMA, SCPC	1995	
	SADC/1	16 States in South African subregion	Intelsat 604	Hybrid	FDMA,DAMA	1999	To be decommissioned after SADS/2
	SADC/2	As above	Intelsat 10-02	Mesh	MF-TDMA or MCPC F.R.	2007 (planned)	To replace SADC/1
	NAFISAT	16 States in N.E. Africa and Middle East	Intelsat 10-02	Mesh	MF-TDMA or MCPC F.R.	2007 (planned	Similar to SADC/2
MID	Egyptian VSAT	Egypt	Intelsat 905	Mesh	MCPC	1991	To be replaced with a new network in 2007
	Yemen VSAT	Yemen	Arabsat 2	Star	MCPC	2000	National use
	Iraq VSAT	Iraq	Asiasat 2	Star	MF-TDMA	2003	National use
	Kuwait VSAT	Kuwait	Asiasat 2	Star	MF-TDMA	2003	National use
	MID VSAT	MID and some neighbouring States	Intelsat 10-02	Mesh	MF-TDMA or MCPC F.R.	2006-7 (Phase one)	Similar to NAFISAT and SADC/2
CAR	CAMSAT	7 States in Central America	Intelsat 805	Mesh	MCPC, DAMA	2000	
	MEVA	12 States in Central Caribbean and COCESNA	PAS-1R	Mesh (with a hub)	SCPC, PAMA and DAMA	1997	to be upgraded to MEVA II
	MEVA II	15 States in Central Caribbean and COCESNA	PAS-1R	Mesh (without a hub)	TDMA F.R.	2006	
SAM	TELESAT	Brazil	Brasilsat 3	Star	TDMA, PAMA and DAMA	1994	National use
	Colombian VSAT	Colombia and 3 neighbouring States	Intelsat 805	Mesh	SCPC, DAMA	2000	
	REDDIG	14 SAM States	PAS-1R	Mesh	MF-TDMA	2003	
Inter-regional	CAFSAT	Argentina, Brazil, Cape Verde, Morocco, Portugal, Senegal, South Africa and Spain	Intelsat 801	Mesh	SCPC and MCPC	2000	

Legend

DAMA	Demand Assigned Multiple Access
FDMA	Frequency Division Multiple Access
F.R	Frame Relay
MCPC	Multi Channel Per Carrier
M.F	Multiple Frequency
PAMA	Permanently Assigned Multiple Access
SCPC	Single Channel Per Carrier
TDMA	Time Division Multiple Access

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