

AERONAUTICAL MOBILE COMMUNICATIONS PANEL (AMCP)

EIGHTH MEETING

Montreal, 4 to 13 February 2003

Agenda Item 5: Review of existing ICAO material on air/ground communication systems

**SUGGESTED CHANGES TO AERONAUTICAL
MOBILE SATELLITE SERVICE (AMSS) SARPS**

(Presented by the Rapporteur of Working Group M)

INFORMATION PAPER

SUMMARY

This paper represents suggested changes to the aeronautical mobile satellite service (AMSS) SARPs which integrates/incorporates the 'CORE' functionality of a next generation satellite service (NGSS) component, the aeronautical mobile satellite route (R) service (AMS(R)S), as well as the AMSS radio spectrum recommendations of the ITU, into a single AMSS SARPs. It is recommended that this 'CORE' functionality could be separated from the more technical details of the AMSS SARPs, which would then be published in a separate manual. The compliance with these standards is recommended as one means of assuring that the system and each subsystem will be implemented as a regulatory document and or advisory documents (e.g. certification, authorization, approval, commissioning, advisory circular, notice, etc.) and may be accepted in whole or in part.

The concept of the core SARPs was accepted at AMCP/WG-M works is continuing on the validation of each element of the core SARPs.

Action by the AMCP is in paragraph 4.

1. INTRODUCTION

1.1 This paper represents suggested changes to the aeronautical mobile satellite service (AMSS) Standards and Recommended Practices (SARPs) which integrates/incorporates the 'CORE' functionality of a next generation satellite service (NGSS) component, as well as the aeronautical mobile satellite route (R) service (AMS(R)S) into the on-going AMSS SARPs development work. Further, it is suggested that the more detailed technical specifications in the current AMSS SARPs could be separated from this 'CORE' section, and published in the form of a manual.

2. NGSS SARPS

2.1 As communications supporting the air traffic service (ATS), aeronautical operational control (AOC), airline administrative control (AAC), and airline passenger communications (APC) may be provided by one or more satellite systems, each of which has particular operating characteristics, it is suggested the current AMSS SARPs scope be expanded to incorporate the operational characteristics of the various components. The compliance with these standards would be recommended as one means of assuring that the system, and each subsystem, will be implemented as a regulatory document and or advisory documents (e.g. certification, authorization, approval, commissioning, advisory circular, notice, etc.) and may be accepted in whole or in part.

2.2 Japan Civil Aviation Bureau (JCAB) has been working on MTSAT project to construct a highly reliable hot stand-by satellite system. Due to the importance of MTSAT-augmented AMSS, a domestic Japan task group was formed to evaluate all the various components of AMSS, as they will ultimately pertain to Japan. This working paper is one product of that task group.

2.3 WG-M has evaluated the functionality and specifications of the AMSS, the specifications being developed for the NGSS, and the specifications being developed for the (AMS(R)S). The results show that a possible way forward exists for the AMSS SARPs drafting process to integrate the functionality and desired specifications of each of these components within a single AMSS SARPs document. This working paper recommends one possible outline for that integrated SARPs document development. At AMCP/7 a set of SARPs and criteria for NGSS systems were developed but kept in abeyance due to the absence of NGSS systems capable of providing AMSS services. In the light of the plans in Japan and Europe to provide these services through NGSS systems, it is now proposed to incorporate this material in Annex 10.

3. CORE SARPS/DETAILED TECHNICAL SPECIFICATION

3.1 This paper also contains a proposal for the current AMSS SARPs to be split in core SARPs and detailed technical specifications. The material in the appendix is intended to remain in Annex 10 (including the additions as per paragraph 2). All other material is intended to move to an appropriate manual.

4. **ACTION BY THE AMCP**

4.1 The meeting is invited to note the material in the appendix as guidance for further work on the splitting of AMSS SARPs into a core section and detailed technical specifications, including the relevant NGSS SARPs.

APPENDIX
PROPOSED AMENDMENT TO
INTERNATIONAL STANDARDS
AND RECOMMENDED PRACTICES
AERONAUTICAL TELECOMMUNICATIONS
ANNEX 10
TO THE CONVENTION ON INTERNATIONAL CIVIL AVIATION
VOLUME III
(COMMUNICATION SYSTEMS)
PART II
(VOICE COMMUNICATION SYSTEMS)

NOTES ON THE PRESENTATION OF THE PROPOSED AMENDMENT TO ANNEX 10

1. The text of the amendment is arranged to show deleted text with a line through it and new text highlighted with grey shading, as shown below:

~~Text to be deleted is shown with a line through it.~~

text to be deleted

New text to be inserted is highlighted with grey shading.

new text to be inserted

~~Text to be deleted is shown with a line through it~~ **followed**
by the replacement text which is highlighted with grey
shading.

new text to replace existing text

2. The proposed amendment stems from the Cospas-Sarsat Council and the Secretariat.

ANNEX 10 — AERONAUTICAL TELECOMMUNICATIONS

VOLUME III — COMMUNICATION SYSTEMS

PART I — DIGITAL DATA COMMUNICATION SYSTEMS

...

CHAPTER 4. AERONAUTICAL MOBILE
SATELLITE SERVICE (AMSS)

...

Note 1.— This chapter contains Standards and Recommended Practices applicable to the use of communications technologies to support Aeronautical Mobile Satellite Service (AMSS) and the aeronautical mobile-satellite (R) service (AMS(R)S) Air Traffic Services and. The Standards and Recommended Practices of this chapter are service- and performance-oriented and are not tied to a specific technology or technique. Each specific AMSS is described in detail in the Technical Specifications associated with this Chapter.

Note 2.— Multiple service providers may offer AMS(R)S, either according to the Standards and Recommended Practices of Annex 10, Part I, Volume III, Chapter 4. This Chapter specifically provides for operation in a mixed environment containing multiple services, including those services specified in Annex 10.

Note 3.— Additional information and guidance is provided in the Manual on Alternative Provisions for AMS(R)S.

4.1 DEFINITIONS

Low Earth Orbits. Satellite orbital paths with an apogee of approximately 1000 nmi (1800 km) altitude, or less.

Medium Earth Orbits. Satellite orbital paths with an apogee of between approximately 1000 nmi (1800 km) and 12000 nmi (20000 km).

Near-Geostationary Orbits. Satellites operating in near-geostationary orbits have an orbit period of 24 hours with an inclination of up to five degrees from the equatorial plane.

Precedence. The order of transmission, or access to system resources, of a message relative to other messages in accordance with defined circumstances. A common application is to order the transmission of messages queued at any given instant by their priority level and order of arrival, with the earliest and highest-priority messages receiving preference.

Satellite system service area. A portion of the Earth's surface within which a satellite-based communications system satisfies the standards of this Chapter. Depending on its design, a system may provide discontinuous service areas.

Note.— The following terms used in this chapter are defined elsewhere in Annex 10:

Aircraft earth station (AES): defined in Annex 10, Volume III, Chapter 1.
Aeronautical telecommunication network (ATN): defined in Annex 10, Volume III, Chapter 1.
Aeronautical mobile-satellite service (AMSS): defined in Annex 10, Volume II, Chapter 1.1.
Aeronautical mobile-satellite (R) service (AMS(R)S): defined in Annex 10, Volume II, Chapter 1.1.*
Data transfer delay (95 percentile): defined in Annex 10, Volume III, Chapter 4.7.2.1.
Data transit delay: defined in Annex 10, Volume III, Chapter 4.7.2.1.
Ground earth station (GES): defined in Annex 10, Volume III, Chapter 1.
Spot beam: defined in Annex 10, Volume III, Chapter 4.1.
Subnetwork layer: defined in Annex 10, Volume III, Chapter 6.1.
Subnetwork service data unit (SNSDU): defined in Annex 10, Volume III, Chapter 4.7.2.1

4.2 GENERAL

4.2.1 When an AMSS is operated to support safety and regularity of flight, it shall conform to the requirements of this Chapter.

4.2.1.1 **Recommendation.**— *To ensure sufficient protection of safety-related CNS systems, AMSS aeronautical equipment not operating to provide AMS(R)S should comply with 4.3.2 of this standard.*

4.2.2 Requirements for mandatory carriage of AMSS equipment including the level of system capability shall be made on the basis of regional air navigation agreements which specify the airspace of operation and the implementation time-scales for the carriage of equipment.

4.2.3 The agreements indicated in 4.2.2 shall provide at least two years' notice of mandatory carriage of airborne systems.

4.2.4 **Recommendation.**— *In accordance with the ICAO Convention, civil aviation authorities should coordinate with national authorities and service providers those implementation aspects of AMSS that will permit its worldwide interoperability and optimum use, as appropriate.*

4.3 DESCRIPTION OF SYSTEM CAPABILITIES

4.3.1 Applicability

4.3.1.1 If the system, as described in the applicable AMSS Technical Manual, provides AMS(R)S packet data service, the service shall conform to 4.6.4 and 4.7.3 of this SARPs

4.3.1.2 If the system, as described in the applicable AMSS Technical Manual, provides AMS(R)S voice service, the service shall conform to 4.6.5 and 4.7.4 of this SARPs

4.3.2 RF Characteristics

4.3.2.1 FREQUENCY BANDS

Note.— ITU Radio Regulations permit systems providing mobile-satellite service to use the same spectrum as AMS(R)S without requiring such systems to offer safety services. This situation has the potential to reduce the spectrum available for AMS(R)S. It is critical that States consider this issue in frequency planning and in the establishment of national or regional spectrum requirements.

4.3.2.1.1 When providing AMS(R)S communications, the AMSS shall operate only in frequency bands in which AMS(R)S is permitted and appropriately protected by ITU Radio Regulations. Each element of the AMS(R)S Subsystem (including AESs, GESs, and the constellation) shall conform with applicable ITU and National radio regulations of each state in the declared service volume.

4.3.2.2 EMISSIONS

4.3.2.2.1 The total EIRP of the AES necessary to maintain system performance shall be controlled to minimize the potential for interference to other systems. This requirement shall apply to single channel AESs, and to each individual channel of AESs that are capable of providing multiple channels.

4.3.2.3 INTERFERENCE TO OTHER AMS(R)S EQUIPMENT

4.3.2.3.1 Emissions from an AMSS AES shall not cause harmful interference to an AES providing AMS(R)S on a different aircraft.

Note.— One method of complying with 4.3.2.2.2.1 is by limiting emissions in the operating band of other AMS(R)S equipment to a level consistent with the intersystem interference requirements (single entry) of Chapter 3.2.5.3.4.2 of RTCA Document DO-215A, Change 1.

4.3.2.4 INTERFERENCE TO OTHER CNS SYSTEMS

4.3.2.4.1 Emissions from an AMSS AES shall not cause harmful interference to non-AMS(R)S CNS systems located on the same aircraft or other aircraft.

Note.— Harmful interference can result from radiated and/or conducted emissions that include harmonics, discrete spurious, intermodulation product and noise emissions, and are not necessarily limited to the "transmitter on" state. It is assumed that installation of the AES and other CNS equipment has been planned and effected so as to optimise performance and minimize interference coupling to susceptible equipment.

4.3.2.4.2 **Recommendation.**— *To assure protection of L-Band satellite navigation services from harmful interference, the average output spectral density of the composite of harmonics, discrete spurious*

and noise emissions created by the AES when transmitting at its maximum total output power should not be greater than -115 dBW/MHz in radio-navigation satellite service band 1559 - 1605 MHz, when measured at the input to the AES antenna over a period of 20 milliseconds.

Note 1.— This recommendation assumes an isolation between the input to the AMS(R)S antenna subsystem and the output of the satellite navigation antenna subsystem of 40 dB and assumes an additional margin of 6 dB relative to the satellite navigation receiver susceptibility requirements established by the GNSS Panel SARPs.

Note 2.— Additional protection of radio-navigation satellite services in the band of 1605-1609.36 MHz from the composite of harmonics, discrete spurious, noise and intermodulation products may be necessary for AES installations made prior to January 1, 2005.

4.3.2.5 SUSCEPTIBILITY

4.3.2.5.1 The AES equipment shall operate properly in an interference environment causing a cumulative relative change in its receiver noise temperature $\Delta T/T$ of 25%.

4.4 PRIORITY AND PREEMPTIVE ACCESS

4.4.1 The AMSS shall ensure that AMS(R)S communications are provided priority access to the radio channels over all other types of AMSS communications, by preemption if necessary.

4.4.2 The AMSS shall support at least 3 levels of safety communications priority. If the system accepts non-safety communication, at least one (lowest) priority level shall be added for non-safety traffic. If the system accepts communication that contain either no priority indication or a null priority indication, each such communication shall be marked upon entry with a non-safety priority level and shall be treated as such in subsequent processing within the system. The AMS(R)S system shall forward a priority indicator to the succeeding subsystem or end-user terminal.

Note.— For the purposes of this document, the three priorities are designated as Distress/Urgency (Highest safety priority), Flight Safety, and other Safety (Lowest safety priority). Non-safety traffic is designated as Non-Safety.

4.4.3 The system shall ensure that higher priority AMS(R)S communications are provided priority access to the radio channels over lower priority AMS(R)S communications, by preemption if necessary.

4.4.4 All AMS(R)S data packets and all AMS(R)S voice call attempts crossing the interface between a GES and a terrestrial network shall be identified as to their associated priority. If terrestrial network have no multiple priorities in this requirement will not applicable.

Note.— Some terrestrial networks, notably those implementing the 1984 version of X.25, may not offer sufficient support for the required prioritization.

4.4.5 Within the same message category, the system shall provide voice communications priority over data communications. An AMS(R)S voice call with a higher service priority than an AMS(R)S call in progress shall be able to preempt the lower service priority call if necessary to gain immediate access to radio channels.

4.5 SIGNAL ACQUISITION AND TRACKING

4.5.1 The AES, GES and satellites shall properly acquire and track service link signals when the aircraft is moving at a cruise speed.

4.5.2 The AES, GES and satellites shall properly acquire and track service link signals when the component of the aircraft acceleration vector in the plane of the satellite orbit is up to (0.6 g).

4.6 PERFORMANCE REQUIREMENTS

4.6.1 Satellite system service area

4.6.1.1 The AMSS should provide a satellite system service area of up to (78 degrees) latitude of the surface of the Earth.

4.6.1.2 **Recommendation.**— *The AMSS should provide a satellite system service area of 100% of the surface of the Earth.*

4.6.2 Failure notification

4.6.2.1 In the event of a service failure, that produces predictable, possibly periodic, outages for some subset of the satellite system service area, the AMSS service provider shall provide timely predictions of the time, location and duration of any resultant outages until full service is restored.

Note.— *Service outages may, for example, be caused by the failure of a satellite, satellite spot beam, or GES. The geographic areas affected by such outages may be a function of the satellite orbit and system design, and may vary with time.*

4.6.3 AES Requirements

4.6.3.1 The AES shall support packet data service, voice service, or both.

4.6.3.2 The AES shall meet the relevant performance requirements contained in 4.6.4 and 4.6.5 for aircraft in straight and level flight throughout the satellite system service area.

4.6.3.2.1 **Recommendation.**— *The AES should meet the relevant performance requirements contained in 4.6.4 and 4.6.5 for aircraft attitudes of +20/-5 degrees of pitch and +/- 25 degrees of roll throughout the satellite system service area.*

4.6.4 Packet data service performance

4.6.4.1 If the system provides AMS(R)S packet data service, it shall meet the standards of the following sub-paragraphs.

4.6.4.1.1 An AMSS providing a packet-data service shall be capable of operating as a constituent mobile sub-network of the ATN. The ATN architecture is predicated on data communications standards developed by ISO, which apply principles of the Open System Interconnect (OSI) model. It is assumed that the ATN's Subnetwork Dependent Convergence Function (SND CF), which is located external to the AMS(R)S air/ground subnetwork has the responsibility for mapping the ATN priority structure to the AMS(R)S priority function. ICAO has published other high-level requirements for the ATN as SARPs and the details are available as an ICAO Manual, Document 9705/2/2 and further explained in the 'Comprehensive ATN Manual'.

Note.— In addition, an AMSS may provide non-ATN data functions.

4.6.4.1.2 DELAY PARAMETERS

Note 1.— The terms used with respect to packet data service performance are based on the definitions in ISO 8348 (first edition). In applying these definitions to the AMSS Subnetwork layer, the word "network" and its abbreviation "N" in ISO 8348 are replaced by the word "Subnetwork" and its abbreviation "S.N.", respectively, wherever they appear.

Note 2.— Subnetwork performance may depend on a number of factors, including intensity of communication traffic. The performance values given here apply during peak busy hours.

4.6.4.1.2.1 *Connection establishment delay.* Connection establishment delay shall not be greater than 70 seconds.

Note.— Connection establishment delay, as defined in ISO 8348, includes a component, attributable to the called Subnetwork service user, which is the time between the S.N.-CONNECT indication and the S.N.-CONNECT response. This user component is due to actions outside the boundaries of the satellite Subnetwork and is therefore excluded from the AMS(R)S specifications.

4.6.4.1.2.2 *Transit delay, from-aircraft, highest priority.* From-aircraft transit delay shall not be greater than 40 seconds for the highest priority data service.

4.6.4.1.2.3 *Transit delay, from-aircraft, lowest priority.* From-aircraft transit delay shall not be greater than 60 seconds for the lowest priority data service.

Note 1.— In accordance with ISO 8348, transit delay values are based on a fixed sub-network service data unit (SNSDU) length of 128 octets. Transit delays are defined as average values.

Note 2.— In any particular AES, lower priority from-aircraft traffic may be subject to additional delay, depending on the amount and rate of from-aircraft traffic loading.

4.6.4.1.2.4 *Transit delay, to-aircraft, highest priority.* To-aircraft transit delay shall not be greater than 12 seconds for the highest priority data service.

4.6.4.1.2.5 *Transit delay, to-aircraft, lowest priority.* To-aircraft transit delay shall not be greater than 40 seconds for the lowest priority data service.

4.6.4.1.2.6 *Data transfer delay (95th percentile), from-aircraft, highest priority.* From-aircraft data transfer delay (95th percentile), shall not be greater than 80 seconds for the highest priority data service.

4.6.4.1.2.7 *Data transfer delay (95th percentile), from-aircraft, lowest priority.* From-aircraft data transfer delay (95th percentile), shall not be greater than 110 seconds for the lowest priority data service.

4.6.4.1.2.8 *Data transfer delay (95 percentile), to-aircraft, highest priority.* To-aircraft data transfer delay (95 percentile) shall not be greater than 15 seconds for the highest priority service.

4.6.4.1.2.9 *Data transfer delay (95th percentile), to-aircraft, lowest priority.* To-aircraft data transfer delay (95th percentile) shall not be greater than 110 seconds for the lowest priority service.

4.6.4.1.2.10 *Connection release delay (95th percentile).* The connection release delay (95th percentile) shall not be greater than 30 seconds in either direction.

4.6.4.1.3 *INTEGRITY*

Note.— Defined as the probability that there are no undetected errors in an information block transferred across the subnetworks, where errors include both undetected addressing errors and undetected errors in the information payload. Residual error rate includes the probability of undetected error, the probability of undetected loss of an SNSDU, undetected errors, and the probability of an undetected duplicate SNSDU.

4.6.4.1.3.1 *Residual error rate, from-aircraft.* The residual error rate in the from-aircraft direction shall not be greater than 10⁻⁶ per SNSDU.

4.6.4.1.3.2 *Residual error rate, to-aircraft.* The residual error rate in the to-aircraft direction shall not be greater than 10⁻⁶ per SNSDU.

4.6.4.1.3.3 *Connection resilience.* The probability of a Subnetwork connection (SNC) provider-invoked SNC release shall not be greater than 10⁻⁴ over any one-hour interval.

Note.— Connection release resulting from GES-to-GES handover, AES log-off or virtual circuit preemption are excluded from this specification.

4.6.4.1.3.4 *The probability of an SNC provider-invoked reset shall not be greater than 0.1 over any one-hour interval.*

4.6.5 Voice service performance

4.6.5.1 If the system provides AMS(R)S voice service, it shall meet the requirements of the following sub-paragraphs.

4.6.5.1.1 *CALL PROCESSING DELAY*

4.6.5.1.1.1 *AES origination.* The 95th percentile of the time delay for a GES to present a call origination event to the terrestrial network-interworking interface after a call origination event has arrived at the AES interface shall not be greater than 20 seconds.

4.6.5.1.1.2 GES origination. The 95th percentile of the time delay for an AES to present a call origination event at its aircraft interface after a call origination event has arrived at the terrestrial network-interworking interface shall not be greater than 20 seconds.

4.6.5.1.2 The total allowable transfer delay within the AMS(R)S Subnetwork on a circuit-mode channel shall not be greater than 0.485 second.

Note.— Total transfer delay for the AMS(R)S Subnetwork is defined as the elapsed time commencing at the instant that speech is presented to the AES or GES and concluding at the instant that the speech enters the interconnecting network of the counterpart GES or AES. This delay includes vocoder processing time, physical layer delay, RF propagation delay and any other delays within the AMS(R)S Subnetwork.

4.6.5.1.3 VOICE QUALITY

4.6.5.1.3.1 The voice transmission shall provide overall intelligibility performance suitable for the intended operational and ambient noise environment.

4.6.5.1.3.2 **Recommendation.**— *Due account should be taken of the effects of tandem vocoders and/or other analog/digital conversions.*

4.6.5.1.4 VOICE CAPACITY

4.6.5.1.4.1 The system shall have sufficient available voice traffic channel resources such that an AES- or GES-originated AMS(R)S voice call presented to the system shall experience a probability of blockage of no more than 0.01.

Note.— Available voice traffic channel resources include all preemptable resources, including those in use by non-AMS(R)S communications.

4.6.6 Security

4.6.6.1 The system shall provide features for the protection of messages End to End.

4.7 SYSTEM INTERFACES

4.7.1 The AMSS shall allow Subnetwork users to address AMS(R)S communications to specific aircraft by means of the ICAO 24-bit aircraft address.

4.7.2 The system shall annunciate a loss of communications capability within 30 seconds of the time when it detects such a loss.

Note.— Provisions on the allocation and assignment of ICAO 24-bit addresses are contained in Annex 10, Volume III, Appendix to Chapter 9.

4.7.3 Packet data service interfaces

4.7.3.1 If the system provides AMS(R)S packet data service, it shall provide an interface to Annex 10, Volume III, Part I, Chapter 3 for the ATN.

Note.— The detailed technical specification related to provisions of ATN-compliant Subnetwork service are contained in Section 5.2.5 and Section 5.7.2 of Doc 9705 — Manual of Technical Provisions for the Aeronautical Telecommunication Network.

4.7.3.2 If the system provides AMS(R)S packet data service, it shall provide a connectivity notification (CN) function. The CN function shall send connectivity notification event messages to the attached ATN Routers.

4.7.4 Voice service interfaces

4.7.4.1 If the system provides AMS(R)S voice services, AES and GES voice signalling and service procedures shall interwork with external telephony networks through a signalling interface consisting of a standardized set of interworking telephony events that conform to a recognized international telephony interface standard.

Note.— There is currently no requirement for AMS(R)S circuit-mode data.

— END —