

RTCA
1828 L Street, NW, Suite 805
Washington, DC 20036

**Guidance on Aeronautical Mobile Satellite Service
(AMSS) End-to-End System Performance**

RTCA DO-215A
February 21, 1995

Prepared by:
SC-165

Copies of this document may be obtained from

RTCA, Incorporated
1828 L Street, NW, Suite 805
Washington, D.C. 20036-5133 U.S.A.

Telephone: 202-833-9339

Facsimile: 202-833-9434

Internet: www.rtca.org

Please contact RTCA for price and ordering information.

FOREWORD

This document was prepared by RTCA Special Committee 165 (SC-165). It was approved by the RTCA Technical Management Committee on February 21, 1995.

RTCA, Incorporated is a not-for-profit corporation formed to advance the art and science of aviation and aviation electronic systems for the benefit of the public. The organization functions as a Federal Advisory Committee and develops consensus based recommendations on contemporary aviation issues. RTCA's objectives include but are not limited to:

- coalescing aviation system user and provider technical requirements in a manner that helps government and industry meet their mutual objectives and responsibilities;
- analyzing and recommending solutions to the system technical issues that aviation faces as it continues to pursue increased safety, system capacity and efficiency;
- developing consensus on the application of pertinent technology to fulfill user and provider requirements, including development of minimum operational performance standards for electronic systems and equipment that support aviation; and
- assisting in developing the appropriate technical material upon which positions for the International Civil Aviation Organization and the International Telecommunication Union and other appropriate international organizations can be based.

The organization's recommendations are often used as the basis for government and private sector decisions as well as the foundation for many Federal Aviation Administration Technical Standard Orders.

Since RTCA is not an official agency of the United States Government, its recommendations may not be regarded as statements of official government policy unless so enunciated by the U. S. government organization or agency having statutory jurisdiction over any matters to which the recommendations relate.

This Page Intentionally Left Blank

TABLE OF CONTENTS

1.1	Purpose and Scope	1
1.2	Document Organization	1
1.3	AMSS System Overview	2
1.3.1	System Architecture	2
1.3.2	The Aeronautical Telecommunications Network (ATN)	4
1.3.3	Service Providers	5
1.4	Communication Services via AMSS	5
1.4.1	Satellite Coverage	5
1.4.2	AMSS Categories	5
1.4.3	Satellite Subsystem Characteristics	6
1.4.4	Circuit-Mode and Packet-Mode Communications	7
1.4.5	AMS(R)S Operational Service Levels	8
1.4.6	Satellite Subsystem Coordination Centers	9
1.4.7	Aircraft-User, Terrestrial and Ground User Subsystems	9
1.5	Operational Applications	9
1.5.1	Air Traffic Services (ATS)	9
1.5.1.1	Air Traffic Control (ATC)	10
1.5.1.2	Flight Information Services (FIS)	10
1.5.1.3	Alerting Service	11
1.5.1.4	Automatic Dependent Surveillance (ADS)	11
1.5.2	Aeronautical Operational Control (AOC)	12
1.5.2.1	AOC Functions	12
1.5.2.2	Operations Services	12
1.5.3	Non-Safety Services	13
1.5.3.1	Aeronautical Administrative Communications (AAC)	13
1.5.3.2	Aeronautical Passenger Communications (APC)	13
1.6	Operational Goals	13
1.6.1	Global Coverage	14
1.6.2	Compatibility and Interoperability	14
1.6.3	Data vs. Voice Communications	14
1.6.4	Safety	14
1.6.5	Priority, Precedence and Preemption	14
2.0	Performance Criteria for End-to-End Applications	15
2.1	End-to-End Packet-Mode Services Performance	19
2.1.1	Integrity	19
2.1.1.1	Residual Packet Error Rate	19
2.1.1.2	Undetected Packet Error Rate	19
2.1.2	Throughput	19
2.2	End-to-End Circuit-Mode Services Performance	20
2.2.1	Grade of Service (GOS)	22
2.2.2	Probability of Misrouting	22
2.2.3	Circuit-Mode Voice Performance	22
2.2.3.1	Voice Quality	22
2.2.3.1.1	Voice Attenuation Distortion	23
2.2.3.1.2	Voice Group Delay Distortion	23
2.2.3.1.3	Voice Signal-Dependent Noise	23
2.2.3.1.4	Voice Idle Channel Noise	23

	2.2.3.2	Voice Transfer Delay	23
	2.2.3.3	Voice Call Setup Delay	24
	2.2.3.4	New Call Initiation Delay	24
2.2.4		Circuit-Mode Data Performance	24
	2.2.4.1	Circuit-Mode Data Bit Error Rate	24
	2.2.4.2	Circuit-Mode Data Bit Rate	24
	2.2.4.3	Circuit-Mode Data Transfer Delay	24
	2.2.4.4	Circuit-Mode Data Call Setup Delay	25
2.3		Priority, Precedence and Preemption	25
	2.3.1	Packet-Mode Priorities	25
2.4		Availability	28
3.0		PERFORMANCE OF SUBSYSTEMS	29
3.1		Aircraft-User Subsystem	29
	3.1.1	Packet-Mode Performance	29
		3.1.1.1 Integrity	29
		3.1.1.2 Throughput	29
		3.1.1.3 Transfer Delay	29
	3.1.2	Circuit-Mode Performance	29
		3.1.2.1 Grade of Service (GOS)	29
		3.1.2.2 Probability of Misrouting	29
		3.1.2.3 Voice Performance	30
		3.1.2.3.1 Voice Attenuation Distortion	30
		3.1.2.3.2 Voice Group Delay Distortion	30
		3.1.2.3.3 Voice Signal-Dependent Noise	30
		3.1.2.3.4 Voice Idle Channel Noise	30
		3.1.2.3.5 Voice Transfer Delay	30
		3.1.2.3.6 Voice Call Setup Delay	30
		3.1.2.3.7 New Call Initiation Delay	31
		3.1.2.4 Circuit-Mode Data Performance	31
		3.1.2.4.1 Circuit-Mode Data Bit Error Rate	31
		3.1.2.4.2 Circuit-Mode Data Bit Rate	31
		3.1.2.4.3 Circuit-Mode Data Transfer Delay	31
		3.1.2.4.4 Circuit-Mode Data Call Setup Time	31
	3.1.3	Priority, Precedence and Preemption	31
	3.1.4	Availability	31
3.2		Satellite Subsystem	31
	3.2.1	Packet-Mode Performance	32
		3.2.1.1 Integrity	32
		3.2.1.1.1 Residual Packet Error Rate	32
		3.2.1.1.2 Undetected Packet Error Rate	32
		3.2.1.2 Throughput	32
		3.2.1.3 Transfer Delay	32
	3.2.2	Circuit-Mode Performance	34
		3.2.2.1 Grade of Service (GOS)	34
		3.2.2.2 Probability of Misrouting	34
		3.2.2.3 Voice Performance	35
		3.2.2.3.1 Voice Transfer Delay	35
		3.2.2.3.2 Voice Call Setup Delay	35

	3.2.2.3.3	New Call Initiation Delay	35
	3.2.2.4	Circuit-Mode Data Performance	36
	3.2.2.4.1	Circuit-Mode Data Bit Error Rate	36
	3.2.2.4.2	Circuit-Mode Data Bit Rate	36
	3.2.2.4.3	Circuit-Mode Data Transfer Delay	36
	3.2.2.4.4	Circuit-Mode Data Call Setup Time	36
	3.2.3	Priority, Precedence and Preemption	36
	3.2.4	Availability	36
	3.2.5	Satellite Subsystem Segments	36
	3.2.5.1	Aircraft Earth Station (AES) Function	36
	3.2.5.2	Ground Earth Station (GES) Function	37
	3.2.5.3	Space Segment RF Links and Coverage	37
	3.2.5.3.1	Transponders	37
	3.2.5.3.2	Coverage Area	37
	3.2.5.3.3	RF Link Performance	37
	3.2.5.3.4	Interference	39
	3.2.5.4	Network Control and Coordination	40
	3.2.5.4.1	Intrasystem Coordination	41
	3.2.5.4.2	Intersystem Coordination	42
	3.2.5.4.3	System Coordination Tables	43
3.3		Terrestrial Subsystem	44
	3.3.1	Packet-Mode Performance	44
	3.3.1.1	Integrity	44
	3.3.1.2	Throughput	44
	3.3.1.3	Transfer Delay	44
	3.3.2	Circuit-Mode Performance	45
	3.3.2.1	Grade of Service (GOS)	45
	3.3.2.2	Probability of Misrouting	45
	3.3.2.3	Voice Performance	45
	3.3.2.3.1	Voice Attenuation Distortion	45
	3.3.2.3.2	Voice Group Delay Distortion	45
	3.3.2.3.3	Voice Signal-Dependent Noise	46
	3.3.2.3.4	Voice Idle Channel Noise	46
	3.3.2.3.5	Voice Transfer Delay	46
	3.3.2.3.6	Voice Call Setup Delay	46
	3.3.2.3.7	New Call Initiation Delay	46
	3.3.2.4	Circuit-Mode Data Performance	46
	3.3.2.4.1	Circuit-Mode Data Bit Error Rate	46
	3.3.2.4.2	Circuit-Mode Data Bit Rate	46
	3.3.2.4.3	Circuit-Mode Data Transfer Delay	46
	3.3.2.4.4	Circuit-Mode Data Call Setup Time	47
	3.3.3	Priority, Precedence and Preemption	47
	3.3.4	Availability	47
3.4		Ground-User Subsystem	47
	3.4.1	Packet-Mode Performance	47
	3.4.1.1	Integrity	47
	3.4.1.2	Throughput	47
	3.4.1.3	Transfer Delay	47
	3.4.2	Circuit-Mode Services Performance	47
	3.4.2.1	Grade of Service (GOS)	48

3.4.2.2	Probability of Misrouting	48
3.4.2.3	Voice Performance	48
3.4.2.3.1	Voice Attenuation Distortion	48
3.4.2.3.2	Voice Group Delay Distortion	48
3.4.2.3.3	Voice Signal-Dependent Noise	48
3.4.2.3.4	Voice Idle Channel Noise	49
3.4.2.3.5	Voice Transfer Delay	49
3.4.2.3.6	Voice Call Setup Delay	49
3.4.2.3.7	New Call Initiation Delay	49
3.4.2.4	Circuit-Mode Data Performance	49
3.4.2.4.1	Circuit-Mode Data Bit Error Rate	49
3.4.2.4.2	Circuit-Mode Data Bit Rate	49
3.4.2.4.3	Circuit-Mode Data Transfer Delay	49
3.4.2.4.4	Circuit-Mode Data Call Setup Time	49
3.4.3	Priority, Precedence and Preemption	49
3.4.4	Availability	50
4.0	OPERATIONAL PERFORMANCE VERIFICATION GUIDELINES	51
4.1	Performance Verification	51
4.2	Verification of AMSS Service Availability	53
	MEMBERSHIP	55

FIGURES

Figure 1-1.	Aeronautical Mobile Satellite Service End-to-End System Model	3
Figure 2-1.	Packet-Mode Services System Structure	16
Figure 2-2.	Circuit-Mode Services System Structure	17
Figure 2-3.	Reference Points for Circuit-Mode Service	18

TABLES

Table 2-1.	End-to-End Transfer Delay Performance (with 600 bps Satellite Subsystem Channel rate)	21
Table 2-2.	End-to-End Transfer Delay Performance (with 10,500 bps Satellite Subsystem Channel Rate)	21
Table 2-3.	AMSS Satellite Subsystem Packet-mode Priority Structure	26
Table 2-4.	AMSS Circuit-Mode Priority Structure	27
Table 3-1.	Satellite Subsystem Transfer Delay Performance (600 bps Satellite Subsystem Channel Rate)	33
Table 3-2.	Satellite Subsystem Transfer Delay Performance (10,500 bps Satellite Subsystem Channel Rate)	33
Table 3-3.	Minimum Carrier-to-Noise Density at the Desired BER	38
Table 3-4.	Required Link Margins	39
Table 4-1.	Verification and Evaluation Method Matrix	52

APPENDIX A	KEY TERMS AND GLOSSARY	1
APPENDIX B	SHARING SPACE SEGMENT RESOURCES	1
APPENDIX C	RF LINK PERFORMANCE	1

This Page Intentionally Left Blank

1.0 INTRODUCTION

1.1 Purpose and Scope

This document contains guidance for the system and service requirements -- performance, availability and integrity -- for an End-to-End System providing Aeronautical Mobile Satellite Services (AMSS) to end users. The primary elements of the End-to-End System are also considered individually. The material should be useful to users, designers, manufacturers and installers of the AMSS system and its elements.

Compliance with these guidelines is recommended as one means of assuring that the AMSS End-to-End system will perform its intended function(s) satisfactorily under all conditions normally encountered in aeronautical operations. Any regulatory application of this document is the sole responsibility of the appropriate authority.

A near-term perspective is taken in anticipating AMSS service development and thus in defining system and service performance criteria. Development can be foreseen in the evolution toward full utilization of AMS(R)S services, and in implementation of the Aeronautical Telecommunications Network (ATN). Certain performance criteria herein may not be met by one or more of the possible modes of operation of AMS(R)S.

Associated with this document is the companion "AMSS Minimum Operational Performance Standards," (MOPS) RTCA Document No. DO-210. It defines the parameters for the Aeronautical Earth Station (AES), a portion of the Satellite subsystem on-board an aircraft, which provides communications functions necessary for air-ground communications via satellite.

1.2 Document Organization

Section 1.0 of this document contains the Introduction, providing an overview of AMSS systems and the applications being planned by users of AMSS.

Section 2.0 establishes the End-to-End System and service criteria for AMSS communications as developed from the expected needs of users and system characteristics. These criteria are expressed in terms of performance, integrity and availability parameters. Section 2 also defines the four primary elements of the End-to-End System.

Section 3.0 addresses the system and service criteria for each of the four Subsystems comprising the End-to-End System -- the Aircraft, Satellite, Terrestrial Distribution and Ground User Subsystems. As the Satellite Subsystem plays the key role in end-to-end AMSS service, particular attention is devoted to that element.

Section 4.0 provides guidelines for verification of the system elements.

Appendix A provides explanation of key terms and acronyms in a glossary.