RTCA, Inc.
1828 L Street, NW, Suite 805
Washington, DC 20036 USA

Change No. 1

-to-

RTCA DO-270

Minimum Aviation System Performance Standards for the Aeronautical Mobile-Satellite (Route) Service (AMS(R)S) as Used in Aeronautical Data Links

System Specific Attachment for Iridium Satellite

© 2009 RTCA, Inc.
RTCA Paper No. 103-09/PMC-718
April 14, 2009

Copies of this document may be obtained from

RTCA, Inc.
1828 L Street, NW, Suite 805
Washington, DC 20036 USA

Telephone: 202-833-9339
Fax: 202-833-9434
Internet: www.rtca.org

Please call RTCA for price and ordering information.

TABLE OF CONTENTS

RTCA DO-270 i
Minimum Aviation System Performance Standards i
System Specific Attachment for Iridium Satellite i
Table of Contents i
1 INTRODUCTION 1
1.1 Objective 1
1.2 Scope 1
1.3 Iridium Satellite Network 2
1.3.1 Overview 2
1.3.2 System Architecture 2
1.3.3 Space Segment 3
1.3.3.1 Terrestrial Segment 5
1.3.4 Channel Classifications 5
1.3.4.1 Overhead Channels 6
1.3.4.2 Bearer Service Channels 7
1.3.5 Channel Multiplexing 7
1.3.5.1 TDMA Frame Structure 7
1.3.5.2 FDMA Frequency Plan 8
1.3.5.3 Duplex Channel Band 8
1.3.5.4 Simplex Channel Band 10
1.3.6 L-Band (1616-1626.5 MHz) Transmission Characteristics 10
1.3.6.1 Signal Format 10
1.3.6.2 Power Control 12
1.3.7 Call Processing 12
1.3.7.1 Acquisition 12
1.3.7.1.1 Acquisition Control 13
1.3.7.2 Access 14
1.3.7.3 Registration and Auto-Registration 14
1.3.7.4 Telephony 14
1.3.7.5 Handoff 16
1.3.8 Voice and Data Traffic Channel 17
1.3.9 Iridium Data Services – RUDICS and SBD 17
1.3.9.1 Iridium RUDICS Service 17
1.3.9.2 Iridium SBD Service 19
1.4 Iridium AMS(R)S System 21
1.4.1 System Overview 23
1.4.2 Aircraft Earth Station (AES) 23
1.4.3 Space Segment 24
1.4.4 Ground Earth Station 24
2 SUBNETWORK PERFORMANCE REQUIREMENTS 25
2.1 General Requirements 25
2.2 Specific Requirements 25
2.2.1 Standard Operating Conditions 25
2.2.2 Spectrum Requirements 26
2.2.2.1 Emission Designators 26
2.2.2.2 Interference 29
2.2.2.2.1 Emissions 29
2.2.2.2.2 Susceptibility 29

2.2.3 Coverage Volume 29
2.2.4 Priority, Precedence and Preemption 30
2.2.4.1 Priority Levels 31
2.2.4.2 Precedence 31
2.2.4.3 Preemption 31
2.2.5 Subnetwork Installed Communications Performance (ICP) 31
2.2.5.1 Transfer Delay 31
2.2.5.1.1 Traffic Model 32
2.2.5.1.2 Subnetwork Model 33
2.2.5.1.3 Transfer Delay Performance 33
2.2.5.1.4 Transfer Delay Characterization 33
2.2.5.2 Integrity 34
2.2.5.3 Service Availability Criteria 35
2.2.5.3.1 Service Outages 35
2.2.5.3.2 Availability Ratio 36
2.2.5.3.3 Multi-User Availability 36
2.2.5.3.4 Single-User Availability 36
2.2.5.4 Continuity of Service Criteria 37
2.2.5.4.1 Continuity of Service Event 37
2.2.5.4.2 Continuity of Service 37
2.2.5.4.3 Multi-User Continuity of Service 37
2.2.5.4.4 Single-User Continuity of Service 38
2.2.6 Service Monitoring 38
2.2.7 Subnetwork Interoperability 38
2.2.7.1 Subnetwork Communications Protocols 39
2.2.7.2 Transparency to User Data 39
2.2.7.3 Interactions with External Elements 39
2.2.7.3.1 Connection Establishment Delay 39
2.2.7.3.2 Connectivity Events 39
2.2.7.3.3 System Control Interactions 39
3 SUBSYSTEM REQUIREMENTS 41
3.1 Performance Partitioning Methodologies 41
3.1.1 RF Performance 42
3.1.2 Transfer Delay Partitioning Methodology 42
3.1.2.1 Latency Transfer Delay Component 42
3.1.2.2 Mean Transfer Delay 42
3.1.2.3 95th Percentile Transfer Delay 42
3.1.3 Integrity Methodology 43
3.1.4 Availability Methodology 43
3.1.4.1 Methodology for Computing Multi-User Availability 43
3.1.4.2 Methodology for Computing Single User Availability 44
3.1.5 Continuity Methodology 44
3.1.5.1 Methodology for Computing Multi-User Continuity of Service 44
3.1.5.2 Methodology for Computing Single User Continuity of Service 45
3.2 AES Subsystem Requirements 46
3.3 Satellite Network Infrastructure (SNI) Requirements 46
3.3.1 SNI Performance Requirements 46
3.3.1.1 RF Link Performance Requirements 46
3.3.1.2 Mitigation of Harmful Interference 46
3.3.1.2.1 Intrasystem Interference 46
3.3.1.2.2 Intersystem Interference 47
3.3.1.3 Network Coordination and Control Function 47

3.3.1.3.1 Intrasystem Coordination 47
3.3.1.3.2 Intersystem Coordination: Same Frequency Band, Same Protocols 48
3.3.1.3.3 Intersystem Coordination: Different Frequency Bands 48
3.3.1.3.4 Intersystem Coordination: Same Frequency Band, Different Protocols 48
3.3.2 SNI Functional Requirements 48
4 SUBNETWORK PERFORMANCE VERIFICATION PROCEDURES 49
4.1 Verification Techniques 49
4.2 Verification of Specific Requirements 50
4.2.1 Standard Operating Conditions 50
4.2.2 Spectrum Requirements 50
4.2.2.1 Emissions Designators 50
4.2.2.2 Interference 51
4.2.2.2.1 Emissions 51
4.2.2.2.2 Susceptibility 51
4.2.3 Coverage Volume 52
4.2.4 Priority, Precedence and Preemption 52
4.2.4.1 Priority Levels 53
4.2.4.2 Precedence 54
4.2.4.3 Preemption 54
4.2.5 Subnetwork Installed Communications Performance 54
Transfer Delay 54
4.2.5.1.1 Traffic Model 55
4.2.5.1.2 Subnetwork Model 55
4.2.5.1.3 Transfer Delay Performance 55
4.2.5.1.4 Transfer Delay Characterization 56
4.2.5.2 Integrity 57
4.2.5.3 Service Availability Criteria 58
4.2.5.3.1 Service Outages 58
4.2.5.3.2 Availability Ratio 58
4.2.5.3.3 Multi-User Availability 59
4.2.5.3.4 Single-User Availability 59
4.2.5.4 Continuity of Service Criteria 60
4.2.5.4.1 Continuity of Service Event 60
4.2.5.4.2 Continuity of Service 60
4.2.5.4.3 Multi-User Continuity of Service 60
4.2.5.4.4 Single User Continuity of Service 61
4.2.6 Service Monitoring 62
4.2.7 Subnetwork Interoperability 62
4.2.7.1 Subnetwork Communications Protocols 62
4.2.7.2 Transparency to User Data 63
4.2.7.3 Interactions with External Elements 63
4.2.7.3.1 Connection Establishment Delay 63
4.2.7.3.2 Connectivity Events 64
4.2.7.3.3 System Control Interactions 64
4.3 Verification of Section 3 Requirements 64

TABLE OF FIGURES

1-1	Key Elements of the Iridium AMS(R)S	3
1-2	Iridium 66-Satellite Constellation	4
1-3	Iridium Spot-Beam Configuration	5
1-4	Iridium Channel Structure Hierarchy	6
1-5	Iridium TDMA Structure	8
1-6	FDMA Frequency Plan	11
1-7	Protocol Partitions	15
1-8	Iridium RUDICS Mobile Originated Data Call Setup	18
1-9	System Architecture of Iridium SBD Service	19
1-10	Setting Up a MO SBD Call (a) Registration (b) Message Delivery	20
1-11	Iridium Aviation Safety Services Air-to-Ground Voice (End-to-End Model)	22
1-12	Iridium Aviation Safety Services Air-to-Air Voice (End-to-End Model)	22
1-13	Iridium Aviation Safety Services Air-to-Ground Data (End-to-End Model)	23
1-14	Iridium Aviation Safety Services Air-to-Air Data (End-to-End Model)	23
1-15	Generic Block Diagram of Aircraft Earth Station	24
2-1	AMS(R)S Subnetwork and Performance Reference Points	26
4-1	Harmonic Bandwidths for Interference Analysis	51
4-2	Example of To-Aircraft-Direction Transfer Delay Measurement System	57

TABLE OF TABLES

1-1	Sub-Band Frequency Allocation	9
1-2	Reuse Unit Frequency Accesses	10
1-3	Simplex Frequency Allocation	10
2-1	*Pro Forma* for Iridium Satellite System Characteristic Declaration	27
2-2	*Pro-forma* Table for Transfer Delay Characteristics	34

GLOSSARY

AAC	Aeronautical Administrative Communications
AC	Acquisition Class
ACCHL	Associated Control Channel, L-Band
AES	Aircraft Earth Station
AOC	Aircraft Operational Communication
APC	Aeronautical Public Correspondence
ATC	Air Traffic Communications (Command)
BPSK	Binary Phase Shift Keying
CC	Call Control
CMU	Communications Management Unit
COCR	Communications Operating Concept and Requirements
CSP	Communications Service Provider
DCE	Data Communications Equipment
DFOA	Differential Frequency of Arrival
DSP	Datalink Service Provider
DTE	Data Terminal Equipment
DTOA	Differential Time of Arrival
FDMA	Frequency Domain Multiple Access
FEC	Forward Error Correction
GES	Ground-Earth Station (Gateway)
GSM	Global System for Mobile Communications
ICAO	International Civil Aviation Organization
ISLLC	Iridium Satellite Limited Liability Corporation
IP	Internet Protocol
LAI	Location Area Identity
LBP	L-Band Physical
LBT	L-Band Transceiver
LL	L-Band Link
MLPPP	Multi-Link Point to Point Protocol
MM	Mobility Management
MO	Mobile Originated
MOPS	Minimum Operation Performance Standards
MT	Mobile Terminated
NGSS	Next Generation Satellite System
OSN	Operational Support Network
PPP	Point to Point Protocol
PSDN	Public Switched Data Network
PSTN	Public Switched Telephone Network
QPSK	Quadrature Phase Shift Keying modulation
RUDICS	Router-Based Unrestricted Digital Interworking Connectivity

	Solution
SBD	Short Burst Data
SDU	Satellite Data Unit
SIM	Subscriber Identity Module card
SNOC	Satellite Network Operations Centre
SV	Space Vehicle (Satellite)
TCP	Transport Control Protocol
TDMA	Time Domain Multiple Access
TE	Terminal Equipment
TMSI	Temporary Mobile Subscriber Identification
TTAC	Telemetry, Tracking, and Control facility
UTC	Universal Coordinated Time

1 INTRODUCTION

1.1 Objective

This document has been prepared in accordance with *DO-270 Minimum Aviation System Performance Standards (MASPS) for the Aeronautical Mobile-Satellite (R) Service (AMS(R)S) as Used in Aeronautical Data Links* as a system specific attachment for the Iridium Satellite System. It contains minimum aviation system performance standards for communications utilizing the Iridium Satellite network for the air-ground communications subnetwork in an Aeronautical Telecommunications Network (ATN). This attachment reflects the Standards and Recommended Practices defined in ICAO Annex 10, Part I, Volume III, Chapter 4 (Chapter 4 SARPS), as revised in 2007.

Compliance with these standards is recommended as one means of assuring that the Iridium Satellite system and its subsystems will perform its intended function(s) satisfactorily under conditions normally encountered in routine aeronautical operations for the environments intended. Any regulatory application of this document is the sole responsibility of appropriate governmental agencies.

The technical characteristics specific to the Iridium Satellite system will be prepared in accordance with this System Specific Attachment. The system specific performance declared in accordance with this attachment will provide one means of assessing whether Iridium Satellite AMS(R)S is appropriate for a specific operational environment. Iridium's system specific performance declaration will not require RTCA publication or approval.

A companion document, the *Iridium Satellite Normative Appendix to the DO-262A Minimum Operational Performance standards (MOPS) for Avionics Supporting Next Generation Satellite Systems (NGSS)*, should be consulted for operational requirements at the air/ground system level, and for details of specific systems providing Iridium AMS(R)S. RTCA documents DO-215A and DO-231 provide overall guidance on data and voice performance.

1.2 Scope

This system specific attachment contains a description of the Iridium Satellite communication system configuration including Ground Subnetworks; Iridium Satellite Subnetworks, of which the Aircraft Earth Station (AES) is one part; and Aircraft Subnetworks. However, the *minimum system performance standards* in this document address only the Satellite Subnetwork.

Section 1 of this attachment provides an informative description of the Iridium Satellite network, focusing on those aspects particular to AMS(R)S. Section 1 provides information needed to understand the rationale for Iridium system characteristics and requirements stated within this document. Definitions and assumptions essential to proper understanding of the Iridium System are provided in this Section, while a more extensive generic glossary can be found in Appendix A of DO-270. Section 1 is intended to be informative in nature and contains no requirements applicable to the Iridium Satellite System.

Section 2 defines the general requirements of an Iridium Satellite AMS(R)S subnetwork, specific requirements for its interfaces, and specific minimum Installed Communications Performance (ICP) requirements when viewed as an air/ground subnetwork of an end-to-end data network. The ICP

© 2009 RTCA, Inc.