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# Safety, Performance and Interoperability Requirements Document for ADS-B Airport Surface Surveillance Application (ADS-B-APT)

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Prepared by: SC-186
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## FOREWORD

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**TABLE OF CONTENTS**


**CHAPTER 1 INTRODUCTION ..... 1**

1.1 PURPOSE OF THE DOCUMENT ..... 1

1.1.1 ADS-B-APT ..... 2

1.1.2 Use of EUROCAE ED-78A and RTCA DO-264 ..... 3

1.1.3 Use of Document for Approvals ..... 3

1.2 SCOPE OF THE DOCUMENT ..... 5

1.2.1 ADS-B-APT Application Context ..... 5

1.2.2 Assumed Airborne & Ground Generic Surveillance Functional Architecture ..... 6

1.3 DEFINITION OF TERMS ..... 8

1.4 STRUCTURE OF THE DOCUMENT ..... 13

1.5 RELATIONSHIP TO OTHER DOCUMENTS ..... 14

1.5.1 ICAO Documents ..... 14

1.5.2 Other RTCA/EUROCAE Documents ..... 14

1.6 REFERENCES ..... 15

1.6.1 ICAO ..... 15

1.6.2 EUROCONTROL ..... 16

1.6.3 EUROCAE/RTCA ..... 16

1.6.4 Other References ..... 17

**CHAPTER 2 APPROACH AND METHODOLOGY ..... 19**

2.1 DOCUMENT DEVELOPMENT PROCESS ..... 19

2.2 METHODOLOGY ..... 19

2.2.1 Operational Services and Environment Definition (OSED) ..... 19

2.2.2 Safety and Performance Requirements (SPR) ..... 20

2.2.2.1 OPA Process ..... 20

2.2.2.2 OSA Process ..... 21

2.2.3 Interoperability Requirements (INTEROP) ..... 22

2.3 KEY TERMS AND KEY WORDS ..... 22

2.3.1 Uses of Requirements and Recommendations and Key Words ..... 23

2.3.2 Assumptions ..... 23

2.3.3 Requirements ..... 24

2.3.4 Recommendations ..... 25

**CHAPTER 3 SAFETY & PERFORMANCE REQUIREMENTS (SPR) ..... 27**

3.1 INTRODUCTION ..... 27

3.1.1 Classification of Assumptions and Requirements ..... 27
3.1.2 Functional Architecture Scope ..... 28
3.1.3 SPR Organization ..... 31
3.2 SCOPE AND ENVIRONMENT ASSUMPTIONS ..... 32
3.2.1 Scope of the Application ..... 32
3.2.2 Scope of the Analysis ..... 33
3.2.3 Operational Environment of the Application ..... 33
3.3 OPERATIONAL REQUIREMENTS ..... 35
3.4 MOBILE DOMAIN SAFETY AND PERFORMANCE REQUIREMENTS ..... 38
3.4.1 Mobile Domain Functional Requirements ..... 38
3.4.2 Mobile Domain Performance Requirements ..... 39
3.4.2.1 ADS-B-APT Data Quality ..... 39
3.4.2.2 Mobile Domain System Continuity and Integrity Requirements ..... 45
3.5 GROUND DOMAIN SAFETY AND PERFORMANCE REQUIREMENTS ..... 45
3.5.1 Ground Domain Functional Requirements ..... 46
3.5.2 Ground Domain Performance Requirements ..... 50
3.5.2.1 Ground Domain System Continuity and Integrity Requirements ..... 51
3.5.2.2 Ground Domain Timing Requirements ..... 51
3.5.3 GNSS Ground Monitoring ..... 53
3.5.3.1 Introduction ..... 53
3.5.3.2 GNSS Ground Monitoring Safety and Performance Requirements ..... 54

**CHAPTER 4 INTEROPERABILITY REQUIREMENTS ..... 55**
4.1 PURPOSE OF INTEROPERABILITY REQUIREMENTS ..... 55
4.2 SCOPE OF INTEROPERABILITY REQUIREMENTS ..... 55
4.2.1 ADS-B-APT Domains ..... 55
4.3 ADS-B-APT INTEROPERABILITY REQUIREMENTS ..... 56
4.3.1 ADS-B Data Link Protocols and Versions ..... 56
4.3.2 Messages and Reports ..... 56
4.3.3 Required Data Items ..... 58
4.3.3.1 Horizontal Position ..... 58
4.3.3.2 Identity Information ..... 59
4.3.3.3 Altitude (Airborne Aircraft) ..... 60
4.3.3.4 Discrete Emergency Modes ..... 60
4.3.4 Recommended Data Items ..... 60
4.3.4.1 Velocity Vector ..... 60
4.3.4.2 Mobile Type and Size ..... 61
4.3.4.3 Mode A Code ..... 61

**ANNEX A – OPERATIONAL SERVICES AND ENVIRONMENT DEFINITION ..... 1**

A.1 INTRODUCTION ..... 1
A.2 CONTEXT ..... 1
A.3 APPLICATION SUMMARY ..... 2
A.4 ENVIRONMENT DEFINITION ..... 3
A.4.1 Introduction ..... 3
A.4.2 Reference Environment ..... 3
A.4.3 Target Environment ..... 4
A.4.4 Surveillance Environment Scenarios ..... 4
A.4.4.1 Scoping the Target Environment ..... 4
A.4.4.2 Selected Environment ..... 4
A.4.5 Scope Clarification ..... 6
A.4.5.1 Equipage ..... 6
A.4.5.2 Alerting ..... 6
A.4.5.3 Economic Factors ..... 6
A.4.5.4 Deployment Transitional Issues ..... 6
A.4.5.5 Security Issues ..... 7
A.4.5.6 Contingency Procedures ..... 8
A.4.5.7 Airborne Surveillance Data Quality ..... 8
A.4.5.8 Aerodrome Protection Zones ..... 8
A.4.5.9 Display of Non-Surveillance based data and information ..... 9
A.4.6 Generic Environment Assumptions ..... 9
A.4.6.1 Use of Surveillance for Area or Approach Control Service ..... 9
A.4.6.2 Operational and Environment Characteristics ..... 10
A.4.6.3 Ground Domain Functionality ..... 20
A.5 APPLICATION DESCRIPTION ..... 21
A.5.1 SMGCS Environment with SMR (APT Reference Procedures) ..... 21
A.5.2 Application Description Operational Assessment ..... 21
A.5.2.1 ATS Surveillance System Capabilities (Chapter 8.1) ..... 22
A.5.2.2 Display (Chapter 8.2) ..... 23
A.5.2.3 Provision of ATS Surveillance Services (Chapter 8.4) ..... 24
A.5.2.4 Use of SSR Transponders and ADS-B Transmitters (Chapter 8.5) ..... 25
A.5.2.5 General Identification Procedures (Chapter 8.6) ..... 25
A.5.2.6 Transfer of Identification (8.6.3) ..... 25
A.5.2.7 Use of ATS Surveillance Systems in the ATC Services (Chapter 8.7) ..... 26
A.5.2.8 Emergencies, Hazards and Equipment Failures (Chapter 8.8) ..... 27
A.5.2.9 Use of ATS surveillance systems in the Aerodrome Control Service (Chapter 8.10) ..... 27
A.5.2.10 Use of SMR Comparison ..... 29
A.5.2.11 Conflict Management on the Airport Surface ..... 29
A.5.2.12 Controllers Roles and Responsibilities ..... 31
A.5.2.13 Flight Crews Roles and Responsibilities ..... 31

A.6 ASSUMPTIONS AND OPERATIONAL REQUIREMENTS ..... 32
A.6.1 Assumptions ..... 33
A.6.2 Operational Requirements ..... 38

**APPENDIX A.I – OPERATIONAL SCENARIOS ..... 1**

**APPENDIX A.II – OPERATIONAL EXAMPLE OF A SAFETY INCIDENT AT AN AIRPORT ..... 1**

**ANNEX B – OPERATIONAL PERFORMANCE ASSESSMENT ..... 1**
B.1 INTRODUCTION ..... 1
B.1.1 Purpose ..... 1
B.1.2 OPA Definitions ..... 1
B.1.3 The CNS/ATM System ..... 2
B.1.3.1 Relevant System Interfaces ..... 2
B.2 ADS-B-APT OPERATIONAL PERFORMANCE ASSESSMENT ..... 2
B.2.1 Scope of the OPA ..... 2
B.2.2 OPA Approach ..... 3
B.3 REQUIRED INFORMATION FOR THE ADS-B-APT APPLICATION ..... 4
B.3.1 Operationally Required ADS-B-APT Information ..... 4
B.3.2 Required Data Items at the Input of the Ground Domain ..... 4
B.3.3 Altitude Information and On-Ground Indication ..... 6
B.3.4 Indication of Surveillance Data Quality ..... 6
B.3.5 Movement and Direction Indication ..... 7
B.3.6 Mobile Type and Size ..... 7
B.3.7 Association of Data Items and Time Stamping ..... 8
B.3.8 Update Interval and Update Probability of Required Data Items ..... 8
B.3.8.1 Update of Position Information ..... 9
B.3.8.2 Update of Emergency Modes ..... 10
B.3.8.3 Update of Non-Changing Items ..... 10
B.3.8.4 Update of Identity Information Changes ..... 10
B.4 METHODOLOGY FOR DETERMINATION OF HORIZONTAL POSITION ACCURACY PERFORMANCE ..... 10
B.4.1 Operational Scenarios with Respect to Airport Physical Size Characteristics ..... 11
B.4.1.1 Scenario #1 (1.A and 1.B): Mobile Crossing Runway ..... 11
B.4.1.2 Scenario #2 (2a and 2b) : Mobile with Taxiway Parallel to Runway ..... 12
B.4.1.3 Scenario #3 (3a and 3b): Mobile on a Runway ..... 13
B.4.1.4 Scenario #4 (4a and 4b): Relative Swapping of Positions During Taxi Operations ..... 13
B.4.1.5 Summary of Misleading Error Magnitudes for the Critical Airport Scenarios ..... 14
B.4.2 Horizontal Position Error Analysis ..... 15
B.4.2.1 Normal Position Accuracy Characteristics ..... 15
B.4.2.2 Position Source Error Characteristics ..... 16

B.4.2.3 Extrapolation Errors due to Latency. ..... 17
B.4.2.4 Co-ordinate Conversion and Mapping Accuracy Characteristics ..... 20
B.4.3 Determining the Position Accuracy Requirement ..... 21
B.4.3.1 Misleading Error in a Direction of Concern ..... 21
B.4.3.2 Position Source Accuracy Requirement ..... 22
B.4.4 Surveillance Data Quality Indicators ..... 23
B.5 OTHER REQUIREMENTS ..... 23
B.5.1 Availability ..... 24
B.5.2 Continuity ..... 24
B.5.3 Surveillance Coverage ..... 24
B.5.4 Capacity ..... 25
B.6 SUMMARY OF PERFORMANCE ASSUMPTIONS AND REQUIREMENTS ..... 26
B.6.1 Assumptions ..... 26
B.6.2 Performance Requirements ..... 28
B.6.3 Performance Recommendations ..... 29

**APPENDIX B.I: ERROR ANALYSIS MODELLING ..... 1**
B.I.1 INTRODUCTION ..... 1
B.I.2 EXTRAPOLATION ERRORS FROM LATENCY ..... 1
B.I.2.1. Latency Components ..... 1
B.I.2.2. Modelling of Latency Distribution ..... 3
B.I.2.3. Effects of Different Message Periods ..... 4
B.I.2.3. Extrapolation Errors due to Latency ..... 5
B.I.2.4. Modelling of Extrapolation Errors for the Most Critical Scenarios ..... 6
B.I.2.5. Errors in the source measurement combined with latency errors ..... 7
B.I.2.6. Simulations ..... 8

**APPENDIX B.II: ANALYSIS OF OPERATIONAL SCENARIOS ..... 1**
B.II.1. INTRODUCTION ..... 1
B.II.2. SCENARIOS 1: CONCERNING MOBILES CROSSING RUNWAY ..... 1
B.II.3. SCENARIOS 2 CONCERNING MOBILES ON TAXIWAY PARALLEL TO RUNWAY ..... 4
B.II.4. SCENARIOS 3: CONCERNING MOBILE ON A RUNWAY ..... 5
B.II.5. SCENARIOS 4: CONCERNING RELATIVE SWAPPING OF POSITIONS ON TAXIWAYS ..... 7

**APPENDIX B.III: SPECIAL CONSIDERATIONS FOR 1090 ES ..... 1**
B.III.1. INTRODUCTION ..... 1
B.III.2. CHARACTERISTICS OF 1090ES FOR STATIONARY AIRCRAFT ..... 1
B.III.3. DISPLAY OF STALE INFORMATION AND LATENCY COMPENSATION ..... 1
B.III.4. EFFECTS ON CRITICAL SCENARIOS ..... 2

**APPENDIX B.IV: ACTUAL PERFORMANCE OF GPS ..... 1**

B.IV.1. INTRODUCTION ..... 1
B.IV.2. ACTUAL PERFORMANCE OF GPS ..... 1
B.IV.3. ONE DIRECTIONAL ERROR DISTRIBUTION ..... 3

**APPENDIX B.V: POSITION ACCURACY RISK MITIGATION ..... 1**
B.V.1. INTRODUCTION ..... 1
B.V.2. SIMPLE MONITORING PRINCIPLES ..... 1
B.V.3. MORE SPECIALIZED MONITORING ..... 2
B.V.4. FURTHER ACCURACY TOLERANCE ..... 3
B.V.5. CONCLUSION ..... 4

**APPENDIX B.VI: VELOCITY ACCURACY ..... 1**
B.VI.1. BACKGROUND ..... 1
B.VI.2. APL/REGULUS STUDY ..... 1
B.VI.2.1. Simulation Overview ..... 1
B.VI.2.2. Modelling Approach ..... 2
B.VI.2.3. Validation Algorithms ..... 2
B.VI.2.4. Simulation Results ..... 4
B.VI.3. EUROCONTROL SKYGUIDE DATA STUDY ..... 5
B.VI.4. CONCLUSIONS ..... 5

**ANNEX C – OPERATIONAL SAFETY ASSESSMENT ..... 1**
C.1 INTRODUCTION ..... 1
C.1.1 Objectives of the OSA ..... 1
C.1.2 Structure of the OSA ..... 1
C.1.3 OSA Definitions ..... 1
C.1.4 Purpose and Scope of the OSA ..... 3
C.2 OPERATIONAL SAFETY ASSESSMENT APPROACH ..... 4
C.2.1 OHA Process ..... 5
C.2.1.1 OHA Purpose ..... 5
C.2.1.2 OHA Scope ..... 5
C.2.1.3 OSA Steps to Perform the OHA ..... 8
C.2.2 Units ..... 13
C.2.3 ASOR Process ..... 14
C.2.3.1 ASOR Purpose ..... 14
C.2.3.2 ASOR Scope ..... 14
C.2.3.3 OSA Steps to Perform the ASOR ..... 14
C.2.4 Role of Actors in the OSA ..... 17
C.3 ADS-B-APT MAIN OSA RESULTS SUMMARY ..... 19
C.3.1 Hazards Identification ..... 19
C.3.2 Hazards Assessment ..... 20

C.3.2.1 Environmental Conditions ..... 20
C.3.2.2 External Mitigation Means ..... 21
C.3.3 Operational Effects, Severity Assignment and Pe Determination ..... 23
C.3.4 Safety Objectives Derivation ..... 27
C.3.5 Internal Mitigation Means ..... 28
C.3.6 Safety Objective Achievement ..... 29
C.3.7 Safety Requirements and Assumptions ..... 31
C.3.8 OSA Conclusion ..... 34
C.4 ADS-B-APT SAFETY ANALYSIS: GENERALITIES ..... 35
C.4.1 Hazards Identified ..... 35
C.4.2 Main Barriers Used in the Event trees ..... 37
C.4.2.1 Weather ..... 37
C.4.2.2 Traffic Characteristics and Phases of Operations ..... 38
C.4.2.3 Controller and Flight Crew (and vehicle operators) Performance ..... 39
C.4.2.4 Notion of Providence ..... 42
C.4.3 Specific notions used in the Fault Tree Analysis ..... 43
C.5 ADS-B-APT SAFETY ANALYSIS: PER HAZARD ..... 50
C.5.1 OH01: Unexpected Loss of Target Information for a Single Mobile ..... 50
C.5.1.1 OH01d - Detected Case of Unexpected Loss of Target Information for a Single Mobile ..... 50
C.5.1.2 OH01u - Undetected Case of Unexpected Loss of Target Information for a Single Mobile ..... 51
C.5.2 OH02: Unexpected Loss of Target Information for Multiple Mobiles ..... 64
C.5.2.1 OH02 Operational Effects ..... 64
C.5.2.2 OH02 Safety Objectives Derivation ..... 65
C.5.2.3 OH02 Fault Tree Analysis ..... 66
C.5.2.4 OH02 Safety Objectives Assessment and Safety Requirements Derivation ..... 70
C.5.3 OH03: Incorrect Horizontal Position Information for a Single Mobile ..... 71
C.5.3.1 OH03d - Detected Case of Incorrect Horizontal Position Information for a Single Mobile ..... 71
C.5.3.2 OH03u - Undetected Case of Incorrect Horizontal Position Information for a Single Mobile ..... 71
C.5.4 OH04: Incorrect Horizontal Position Information for Multiple Mobiles ..... 89
C.5.4.1 OH04d: Detected Case of Incorrect Horizontal Position Information for Multiple Mobiles ..... 89
C.5.4.2 OH04u: Undetected Case of Incorrect Horizontal Position Information for Multiple Mobiles ..... 90
C.5.4.3 OH04u Operational Effects ..... 90
C.5.4.4 OH04u Safety Objectives Derivation ..... 91
C.5.4.5 OH04u Fault Tree Analysis ..... 91
C.5.5 OH05: False Target(s) ..... 94
C.5.5.1 OH05d: Detected Case of False Target(s) ..... 94
C.5.5.2 OH05u: Undetected Case of False Target(s) ..... 94
C.5.6 OH06: Incorrect Identity Information for a Single Mobile ..... 97
C.5.6.1 OH06d: Detected Case of Incorrect Identity Information for a Single Mobile ..... 97
C.5.6.2 OH06u: Undetected Case of Incorrect Identity Information for a Single Mobile ..... 98

C.5.7 OH07: Incorrect Identity Information for Multiple Mobiles ..... 103
C.5.7.1 OH07d: Detected Case of Incorrect Identity Information for Multiple Mobiles ..... 103
C.5.7.2 OH07u: Undetected Case of Incorrect Identity Information for Multiple Mobiles ..... 104
C.5.7.3 OH07u-1, Corruption of Identity Information for Multiple Mobiles ..... 104
C.5.7.4 OH07u-2, Identity Information Swap ..... 107
C.5.8 OH08: Unexpected Loss of Identity Information for a Single Mobile ..... 108
C.5.9 OH09: Unexpected Loss of Identity Information for Multiple Mobiles ..... 109
C.5.10 OH10: Incorrect but Plausible Discrete Emergency Code for a Single Aircraft ..... 109
C.5.10.1 OH10 Operational Effects ..... 110

**APPENDIX C.I- FAULT TREE ANALYSIS FOR ADS-B-APT WHEN CONSIDERING POSITION ACCURACY MONITORING IN THE GROUND DOMAIN ..... 1**

C.I.1. INTRODUCTION ..... 1
C.I.2. PURPOSE OF GNSS GROUND MONITORING ..... 1
C.I.3. IMPACT OF GNSS GROUND MONITORING ON ADS-B-APT HAZARDS ..... 2
C.I.4. ASOR ANALYSIS OF HAZARDS IMPACTED BY GNSS GROUND MONITORING ..... 3
C.I.4.1. OH02 Fault Tree Analysis with GNSS Ground Monitoring ..... 3
C.I.4.2. OH03u Fault Tree Analysis with GNSS Ground Monitoring ..... 5
C.I.4.3. OH04u Fault Tree Analysis with GNSS Ground Monitoring ..... 6

**APPENDIX C.II- FAULT TREES SYMBOLS LEGEND ..... 1**

**APPENDIX D- ACRONYMS ..... 1**

**APPENDIX E- LIST OF PARTICIPANTS ..... 1**

E.1. RFG PARTICIPANTS ..... 1
E.2. EUROCAE WORKING GROUP 51 PARTICIPANTS ..... 2

## TABLE OF TABLES


| | | |
|---|---|---|
| Table 1 | Mobile Domain Functions Description | 30 |
| Table 2 | Ground Domain Functions Description | 31 |
| Table 3 | Assumptions on the Application Scope | 32 |
| Table 4 | Assumptions on the Analysis Scope | 33 |
| Table 5 | Assumptions on the Environment | 34 |
| Table 6 | Operational Requirements | 36 |
| Table 7 | Operational Assumptions | 37 |
| Table 8 | Mobile Domain Functional Requirements and Assumptions | 39 |
| Table 9 | ADS-B-APT Data Quality Requirements | 41 |
| Table 10 | ADS-B-APT Data Quality Assumptions | 42 |
| Table 11 | Mobile Domain System Integrity Requirement and ContinuityAssumption | 45 |
| Table 12 | Ground Domain Functional Requirements | 47 |
| Table 13 | Ground Domain Functional Assumptions | 49 |
| Table 14 | Ground Domain Functional Recommendation | 50 |
| Table 15 | Ground Domain System Continuity and Integrity Requirements and Assumption | 51 |
| Table 16 | Ground Domain Timing Requirements | 52 |
| Table 17 | Ground Domain Timing Assumptions | 53 |
| Table 18 | Ground Domain Timing Recommendation | 53 |
| Table 19 | GNSS Ground Monitoring Functional Recommendation | 53 |
| Table 20 | Ground Monitoring Requirements | 54 |
| Table 21 | Ground Monitoring Assumptions | 54 |

| | | |
|---|---|---|
| Table A.1 | Summary of Airport Environment Characteristics | 5 |
| Table A.2 | ICAO Annex 14 Aerodrome Reference Codes | 15 |
| Table A.3 | ICAO Annex 14 Conversion to ARC Runway Width | 15 |
| Table A.4 | Minimum Width Runway and Taxiway Design Standards | 16 |
| Table A.5 | Taxiway Minimum Separation Distances | 17 |
| Table A.6 | Minimum Distances according to Code numbers | 18 |
| Table A.7 | Summary of OSED Assumptions | 33 |
| Table A.8 | Summary of Operational Requirements | 38 |

Table B.1 Required Data Items at the Input of the Ground Domain ..... 5
Table B.2 Magnitudes for Misleading Position Errors ..... 14
Table B.3 Summary of OPA Assumptions ..... 26
Table B.4 Summary of OPA Requirements ..... 28
Table B.5 Summary of OPA Recommendations ..... 29
Table B.6 Comparison of Double and Single Gaussian Distributions ..... 8
Table B.7 Mean Latency Distribution ..... 7
Table B.8 Actual Performance of GPS – US Analysis ..... 2
Table B.9 Actual Performance of GPS – EUROCONTROL Analysis ..... 3
Table B.10 Comparison of Error Bounds ..... 4
Table B.11 Field Data Results ..... 3
Table B.12 Simulation Results ..... 4
Table B.13 Results from fixed GPS receiver. ..... 5

Table C.1 Hazards Classification Matrix (from ED-78A/DO-264) ..... 7
Table C.2 Safety Targets from US FAA SMS Approach ..... 10
Table C.3 Safety Targets from European Approach ..... 11
Table C.4 Number of ATM Hazards per Severity Class in an Airport of Complexity 2 ..... 12
Table C.5 Number of ATM Hazards per Severity Class in an Airport of Complexity 2 ..... 13
Table C.6 Roles of OSA Actors ..... 18
Table C.7 ADS-B-APT Hazards ..... 19
Table C.8 ADS-B-APT Environmental Conditions ..... 20
Table C.9 ADS-B-APT External Mitigation Means ..... 22
Table C.10 Most Demanding Operational Effects, Severity Class and Pe per ADS-B-APT OH ..... 24
Table C.11 Comparison of the number of OHs per Severity Class – ESARR4 Approach ..... 26
Table C.12 ADS-B-APT Safety Objectives per Operational Hazard ..... 27
Table C.13 Internal Mitigation Means ..... 29
Table C.14 ADS-B-APT Safety Objectives Achievement ..... 30
Table C.15 ADS-B-APT Safety Requirements ..... 32
Table C.16 ADS-B-APT Safety Assumptions ..... 32
Table C.17 Duration of each Phase of Operation ..... 39
Table C.18 Mobile Domain Hazard Contributions of Continuity Failures ..... 48
Table C.19 Mobile Domain Hazard Contributions of Integrity Failures ..... 49
Table C.20 OH01u List of identified barriers ..... 56

Table C.21 OH01u Probability of Effect of each Severity Class ..... 58
Table C.22 OH01u Derivation of Safety Objective ..... 58
Table C.23 OH01u Basic Causes ..... 62
Table C.24 OH01u Safety Requirements / Assumptions Derivation ..... 64
Table C.25 OH02 Probability of Effect of each Severity Class ..... 65
Table C.26 OH02 Derivation of Safety Objective ..... 66
Table C.27 OH02 Basic Causes ..... 70
Table C.28 OH02 Safety Requirements / Assumptions Derivation ..... 71
Table C.29 OH03u-A List of identified barriers ..... 81
Table C.30 OH03u-B List of identified barriers ..... 83
Table C.31 OH03u-A Probability of Effect of each Severity Class ..... 84
Table C.32 OH03u-B Probability of Effect of each Severity Class ..... 85
Table C.33 OH03u-A Derivation of Safety Objectives ..... 85
Table C.34 OH03u-B Derivation of Safety Objectives ..... 85
Table C.35 OH03u Basic Causes ..... 88
Table C.36 OH03u Safety Requirements / Assumptions Derivation ..... 89
Table C.37 OH04u Basic Causes ..... 93
Table C.38 OH04u Safety Requirements/Assumptions Derivation ..... 94
Table C.39 OH05u Basic Causes ..... 96
Table C.40 OH05u Safety Requirements/Assumptions Derivation ..... 97
Table C.41 OH06u Basic Causes ..... 103
Table C.42 OH06u Safety Requirements and Assumptions ..... 103
Table C.43 Impact of GNSS Ground monitoring on ADS-B-APT hazards ..... 3
Table C.44 OH02 Basic Cause DATA_MON_FA ..... 4
Table C.45 OH02 New Safety Requirement ..... 5
Table C.46 OH04u Basic Cause DATA_MON_MD ..... 7
Table C.47 OH04u New Safety Requirement ..... 8

## TABLE OF FIGURES


| | | |
|---|---|---|
| Figure 1 | Generic Surveillance Functional Architecture for all ADS-B Applications | 7 |
| Figure 2 | Traceability Scheme | 25 |
| Figure 3 | Surveillance Functional Architecture for the ADS-B-APT Application | 29 |
| Figure A.1 | Trabzon (Turkey) Aerodrome Chart | 12 |
| Figure A.2 | Windsor Locks (USA) Aerodrome Chart | 12 |
| Figure A.3 | Milwaukee (USA) Aerodrome Chart | 12 |
| Figure A.4 | Paris Orly (France) Aerodrome Chart | 13 |
| Figure A.5 | Glasgow (UK) Aerodrome Chart | 13 |
| Figure A.6 | Separation Between Departing and Arriving Aircraft | 30 |
| Figure A.7 | Scenario 1.A – Mobile Holding or Approaching Hold Bar (Perceived Threat) | 1 |
| Figure A.8 | Scenario 1.B – Mobile is Crossing Runway (Real Threat Depicted as Non-Threat) | 2 |
| Figure A.9 | Scenario 2.A – Mobile on Adjacent Taxiway | 2 |
| Figure A.10 | Scenario 2.B – Mobile on Runway | 3 |
| Figure A.11 | Scenario 3.A – Mobile Perceived to be Moving when in Fact it is Not | 3 |
| Figure A.12 | Scenario 3.B –Mobile Appears Stationary but is Rolling | 4 |
| Figure A.13 | Scenario 4.A – Along Track Swap | 4 |
| Figure A.14 | Scenario 4.B – Cross Track Swap | 5 |
| Figure A.15 | Events Leading to the CKS Accident on 31 October 2000 | 1 |
| Figure B.1 | Limiting Case of Physical Characteristics of Scenario #1 | 11 |
| Figure B.2 | Limiting Case of Physical Characteristics of Scenario #2 | 12 |
| Figure B.3 | Limiting Case Physical Characteristics of Scenario #4 | 13 |
| Figure B.4 | Example of the Time Correlation of GPS Errors | 17 |
| Figure B.5 | Components of Along-Track Total Position Error | 18 |
| Figure B.6 | Illustration of the One Dimensional Error Distribution | 21 |
| Figure B.7 | Along Track Forward Error Bounds | 22 |
| Figure B.8 | Latency Time Line from Measurement to Display | 1 |
| Figure B.9 | Message Rate and Probability of Detection Modelling | 2 |
| Figure B.10 | Probability Density Distribution of Latency for Different P1 Values | 4 |
| Figure B.11 | Cumulative Probabilities of Latency (Showing Tails on a Log Scale) | 4 |

Figure B.12 Probability Density Distribution of Latency for Different Message Periods ..... 5
Figure B.13 Cumulative Probabilities of Latency (Showing Tails on a Log Scale)..... 5
Figure B.14 Cumulative Probabilities of Extrapolation Errors for Different Speed Errors..... 7
Figure B.15 Probability Density Distribution (per Sample) for Position Source ..... 9
Figure B.16 Cumulative Probabilities (per Sample) for Position Source..... 9
Figure B.17 Along Track Forward Error Bounds..... 11
Figure B.18 Along Track Forward Error Bounds..... 11
Figure B.19 Along Track Forward Error Bounds..... 12
Figure B.20 Scenario 1.A Mobile Holding or Approaching Hold Bar (Perceived Threat) ..... 2
Figure B.21 Scenario 1.B - Mobile is Crossing Runway ..... 3
Figure B.22 Scenario 2.A - Mobile on Adjacent Taxiway..... 4
Figure B.23 Scenario 3.A - Aircraft Perceived to be Moving when in Fact it is not..... 5
Figure B.24 Scenario 3.B – Aircraft Appears to be Stationary ..... 6
Figure B.25 Scenario 4.A – Along Track Swap..... 7
Figure B.26 Aircraft Accelerating to Significant Movement Distance ..... 3
Figure B.27 Event Rate of Exceeding the 22.5m Misleading Error Threshold..... 3

Figure C.1 OSA Process Overview..... 5
Figure C.2 OHA Steps ..... 8
Figure C.3 Probability “Pe” per Hazard-Effect Pair Scheme..... 9
Figure C.4 ASOR Steps ..... 15
Figure C.5 Example of Fault Tree Structure ..... 15
Figure C.6 OSA Context of Integrity and Continuity Requirements – Data Loss ..... 44
Figure C.7 OSA Context of Integrity and Continuity Requirements – Misleading Data ..... 45
Figure C.8 Basic Causes for Integrity and Continuity Failures..... 47
Figure C.9 Potential Threat Generated Due to a Target not Displayed on the Display..... 51
Figure C.10 Existing Threat not Displayed on the Display..... 52
Figure C.11 OH01u Event Tree ..... 54
Figure C.12 OH01u Fault Tree..... 61
Figure C.13 OH02 Fault Tree..... 68
Figure C.14 OH02 Fault Tree (cont’d)..... 69
Figure C.15 OH03u Case A – Mobile Holding at Hold Bar (Non-Threat Depicted as Threat) ..... 74
Figure C.16 OH03u Case B - Mobile is Crossing Runway (Real Threat Depicted as Non-Threat)..... 74
Figure C.17 OH03u-A Event tree: Non threat seen as a threat ..... 78

Figure C.18 OH03u-B Event tree: Real threat seen as a non threat ..... 79
Figure C.19 OH03u Fault Tree..... 87
Figure C.20 OH04u Fault Tree..... 92
Figure C.21 OH05 Fault Tree..... 96
Figure C.22 OH06u Fault Tree..... 102
Figure C.23 OH07u-1Fault Tree ..... 106
Figure C.24 OH07u-2 Fault Tree ..... 108
Figure C.25 OH02 Fault Tree with GNSS ground monitoring ..... 5
Figure C.26 OH04u Fault Tree..... 7

# CHAPTER 1 INTRODUCTION

This standard provides the minimum operational, safety and performance requirements (SPR) and interoperability requirements (INTEROP) for the implementation of the Automatic Dependent Surveillance-Broadcast Airport Surface Surveillance Application (ADS-B-APT). The ADS-B-APT application is fully defined in the Operational Services and Environment Definition (OSED) found in Annex A.

This document was developed based on the criteria for SPR and INTEROP documents set forth in RTCA DO-264/EUROCAE ED-78A, "Guidelines for Approval of the Provision and Use of Air Traffic Services Supported by Data Communications" [14]. It provides the minimum ADS-B-APT application requirements - and allocations thereof - based on the results of a coordinated requirements determination process, performed by the ADS-B Requirements Focus Group (RFG).

The RFG was established through the EUROCONTROL/FAA Memorandum of Cooperation. It operates as a joint EUROCAE and RTCA activity assuming the responsibility for the SPR and INTEROP standard material contained in this document. All material in this document was developed jointly by EUROCAE Working Group 51 and RTCA Special Committee 186.

The requirements contained in this document are necessary to provide adequate assurance that the appropriate aspects of the relevant Communication Navigation Surveillance and Air Traffic Management (CNS/ATM) system, when operating together, will perform their intended function in an acceptably safe manner for the operations defined in the OSED.

Whilst all detailed SPR related assessments are found in Annexes to this document, Chapter 3 presents the outcome of the reconciliation process of all of these results into a single set of underlying Safety and Performance Requirements. This process retains the most stringent requirements for those attributes or parameters commonly treated by both the safety and performance assessments. Traceability of those requirements back to the corresponding assessment(s) is (are) provided.

## 1.1 PURPOSE OF THE DOCUMENT

This document defines and allocates the set of minimum requirements for the end-to-end operational, safety, performance and interoperability aspects for implementations of the ADS-B-APT application. Allocation of these requirements is done by this SPR/INTEROP to the necessary domains of the CNS/ATM system, i.e. at Transmit ADS-B Mobile Domain level (referred to simply as the Mobile Domain, where a Mobile designates a transmitting aircraft or vehicle and Receiving ADS-B Ground Domain level (referred to simply as the Ground Domain).

These requirements can be used as a component for approval processes including aircraft type design approval, aircraft operator operational approval and Air Traffic Services (ATS) provider operational approval. This SPR/INTEROP document is also written to support system specific standards (e.g. Minimum Operation Performance Standards - MOPS, Technical Standards Order - TSOs) which will be required for many airspace regulators.

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In addition, this document provides guidance to determine the levels of design assurance and performance for each element (aircraft, ground vehicle, operator and Air Navigation Service Provider (ANSP)) to support the ADS-B-APT application.

The ADS-B-APT application SPR/ INTEROP standards are also envisaged to be used along with those from other surveillance applications based on ADS-B to develop minimum standards for avionic systems and ground surveillance systems to assure that all subsystems perform their intended functions adequately for these applications.

### 1.1.1 ADS-B-APT

The ADS-B-APT application aims at enhancing aerodrome operations by adding ADS-B surveillance to a non-surveilled aerodrome and providing the controller with an appropriate graphical display to view the surveillance data.

The ADS-B-APT application will provide the controller with a display of the airport layout (showing as a minimum runway and taxiway boundaries) and the positions of the Mobiles on the Manoeuvring Area, along with the surveillance data associated to those Mobiles, where the term "Mobile" refers to an aircraft or a ground vehicle circulating on the Manoeuvring Area.

The surveillance data is intended to augment the controller's situational awareness and help the controller to manage the traffic in a more efficient way. The ADS-B-APT application will support the controller in performing the Aerodrome Control Service tasks, for example to assist in the detection of runway incursions. In this respect, the application does not aim to reduce the occurrence of runway incursions, but may reduce the occurrence of runway collisions by assisting in the detection of the incursions.

Controllers use radio communications and out the window scans, as well as manual aide-memoires to obtain and maintain traffic situational awareness in support of the Aerodrome Control Service. As visual observation is the primary source of Mobile situation awareness, ADS-B-APT is expected to bring its greatest efficiency benefits in poor Visibility Conditions, when visual observation may become difficult and the controller becomes more reliant on voice and other aids.

The most similar existing environment to the ADS-B-APT environment is an environment with a Surface Movement Radar (SMR) in that both are designed as an augmentation to Aerodrome Procedures and not designed to be used on their own (such as for A-SMGCS). As such, it has been described as the Reference Environment, against which the Target Environment (with ADS-B-APT) is operationally compared to derive most of the assumptions to be used for the performance (OPA) and safety (OSA) analyses of the ADS-B-APT application.

In the Target Environment, all existing procedures for flight crews and controllers used for Aerodrome Operations remain valid and unchanged when compared to the Reference Environment, except transponder procedures which will be required to be applied before entering the Manoeuvring Area. Flight crew and controller roles and responsibilities are also unchanged by the introduction of ADS-B-APT. Further, the design of the airport is unchanged with the introduction of ADS-B-APT.

Some data items that ADS-B provides (e.g. identification) are not available in the SMR environment. In this regard, guidance is provided on identification procedures, though there are no new procedures relating to the identification of Mobiles. The controller may correlate the callsign with the Mode A code (A-SMGCS provides some

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source of this procedure - see ICAO Doc 9830 [6] §3.4.1.9) or use direct recognition of the Mobile's Identity Information in the ADS-B label as per ICAO Doc 4444 – PANS-ATM, [1] § 8.6.2.2 (a). See Annex A §A.5.2.9 and ASSUMP.25.

For this analysis, the Target Environment is assumed to be a simple to complex aerodrome layout with many taxiways, possibly multiple terminals and aprons and possibly multiple runways, but limited up to two active runways at a time, with ADS-B as a unique means of surveillance. 100% ADS-B OUT qualified equipage for the Mobiles on the Manoeuvring Area is assumed (the Mobiles are assumed to be equipped with a GNSS receiver). It is assumed that the airspace (including airports) is regulated so that all aircraft and ground vehicles are fully compliant with the minimum ADS-B-APT requirements expressed in this document. Visibility Conditions 1, 2 and 3 are considered in the analysis.

The analysis of the ADS-B-APT application considers an environment in which SMGCS procedures are applied, but recognises in the safety analysis that controllers or flight crews may sometimes fail to follow some procedures, thereby creating unsafe situations. The scenarios in the safety analysis consider these situations where there might be a potential threat.

It's important to highlight that the analysis only considers authorised and qualified ADS-B transmitting Mobiles[1] [2], hence the two following limitations apply with respect to security aspects:

- It is recognised that the ADS-B-APT application is not designed to assist in the detection of Intruders, as they are not authorized and/or not equipped. For the analysis, it is assumed that the risk of an Intruder is directly related to the level of security measures implemented at the local airport and not related to surveillance.
- Intentional or deliberate interferences or disturbance of the ADS-B surveillance system are out of scope of this analysis.

### 1.1.2 Use of EUROCAE ED-78A and RTCA DO-264

This document was developed in accordance with the criteria for SPR and INTEROP standards set forth in EUROCAE ED-78A and RTCA DO-264, "Guidelines for Approval of the Provision and Use of Air Traffic Services Supported by Data Communications" [14].

Wherever appropriate, the ED-78A/DO-264 guidelines have been refined to serve the determination of surveillance application requirements. In particular, as applicable to all RFG applications, more detailed safety assessment guidance has been established, which can be found in the Operational Safety Assessment (OSA) found in Annex C.

### 1.1.3 Use of Document for Approvals

This document is intended to support the approval of all elements of the CNS/ATM system relating to the ADS-B-APT application.

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[1] As it is assumed for the ADS-APT application that there is 100% equipage on the Manoeuvring Area, the term "Mobile" is used throughout the document to imply "qualified ADS-B transmitting aircraft or ground vehicle, equipped with GNSS receiver equipage".

[2] The proportion of equipped mobiles is an issue which is too locally dependent to make assumptions on the percentage of equipage. Therefore, 100% equipage has been assumed for the analysis, and local implementers will need to consider the impact on the analysis if the proportion of equipped mobiles on their aerodrome surface differs significantly from this.

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This joint standard has been developed by the Requirement Focus Group - RFG. This working group represents a large panel in Air Traffic Management and Aviation expertise, bringing a large number of perspectives, in particular from industry, and consists of members from FAA, EUROCONTROL, RTCA and EUROCAE with participation of AirServices Australia, NAV Canada and Japan, providing technical and operational expertise to RFG activities.

The large number of RFG participants, the variety of perspectives (US, Europe, etc), the involvement of operational people (controllers and pilots), the number of ANSPs including future European implementers, are all elements which contribute to demonstrate that the RFG brought key competence to apply the mentioned methodologies and approaches and to show that all the requirements are achievable in a generic implementation of the ADS-B-APT system.

**IMPORTANT**: The corresponding safety, performance and interoperability assessments are based on the detailed specification of the OSED. States or regions implementing an application different to that specified in the OSED must take into account those differences in the operations or environment in supporting analyses and must analyze the impact of these differences on the requirements. It is the responsibility of any ATS provider using this document, and wishing to implement ADS-B-APT, to ensure that the various conditions and assumptions mentioned in this document are applicable for the local Target Environment. The local implementing authorities should also consider the following assumptions:

- Implementing authorities are assumed to review and assess their local aerodrome procedures with respect to any impact of the ADS-B surveillance, as part of the local safety assessment and implementation activities.. (ASSUMP-OSED.33)
- ATS authorities are assumed to ensure that Aerodrome Control Service procedures and conditions are prescribed such that the availability and use of the ADS-B surveillance system is not detrimental to visual observation of aerodrome traffic. (ASSUMP-OSED.40)

All the assumptions in the SPR and the Annexes have to be considered in the development of a Local Safety Case before implementing the ADS-B-APT application.

Information for the local ATS provider on adapting this SPR standard to a local implementation can be found in §1.3.3 of ED-78A/DO-264 [14]. Guidelines for qualifying a CNS/ATM system element to an SPR standard can be found in §5 and §6 of ED-78A/DO-264. Additional information to be considered is provided in Annex C of this document, e.g. the applied risk classification scheme for Operational Hazards.

The Ground Domain requirements expressed in this document are applicable to the "ATS Provider" domain and can be found in Chapter 3 and respective Annexes. The assessments and specifications in this document are not intended to be the sole basis for operational and airworthiness approval. However, this material can be used as an important component for establishing minimum design and system performance standards for ANSP, aircraft operator and aircraft certification approvals for the ADS-B-APT application.

Ground surveillance system designers should consider any additional specifications that may enhance the system supporting the ADS-B-APT application in view of other future Ground Surveillance Applications (GSA) so that systems designed for the ADS-B-APT application will easily accommodate more demanding ADS-B enabled operations in the future.

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**IMPORTANT**: This standard is intended to provide the basis for demonstrating that an implemented system can meet the relevant operational, safety, performance and interoperability requirements for services performed within the operational limitations defined herein. This standard is not intended to constrain the use of an implementation only to the services and operational limits defined herein. In cases where ATS providers intend to support expanded operations or wish to define new services, corresponding changes or additions to the operational, safety, performance and interoperability requirements addressed in this document will need to be considered.

## 1.2 SCOPE OF THE DOCUMENT

This document includes the definition of the services and the environmental conditions relevant to the implementation of the ADS-B-APT application and the Operational, Safety, Performance and Interoperability Requirements for using the application.

- Transitional issues are beyond the scope of this document.
- Requirements related to the recording of ADS-B data for accident or incident investigation purposes are beyond the scope of this document.
- Intruder issues are beyond the scope of this document
- Requirements that provide protection against intentional behaviour causing harm or sabotage are beyond the scope of this document.

The detailed scope assumptions can be found in §3.2.2.

### 1.2.1 ADS-B-APT Application Context

The ADS-B-APT application is one of many envisioned applications that rely on the participation of ADS-B OUT equipped Mobiles. There is a strong expectation that ADS-B OUT will be implemented widely using, for example, the published SPR/INTEROP documents for GSAs such as ADS-B-NRA (ED-126/DO-303) and ADS-B-RAD (ED-161/DO-318). Furthermore, some SPR/INTEROP documents for Airborne Surveillance Applications (ASA) are already published (i.e. ATSA-ITP (ED-159/DO-312), ATSA-VSA (ED-160/DO-314), ATSA-AIRB (ED-164/DO-319) ATSA-SURF (ED-165/DO-xx). This document has therefore been developed considering the assessments of these GSAs and ASAs.

The ADS-B-APT application is one of the applications originally defined as a first package of Ground and Airborne Surveillance Applications enabled by ADS-B and collectively called “Package 1” [12]. All applications defined within Package I are enabled by ADS-B given a sufficient level of equipage of Mobiles broadcasting ADS-B information and/or ground stations and/or other Mobiles receiving and processing that same data.

This document considers the ADS-B-APT application as an isolated application and it should be noted that system requirements that satisfy the ADS-B-APT application do not necessarily satisfy others. Implementation of all Package 1 applications will require harmonization of minimum system requirements to facilitate interoperability

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