



AeroMACS Standardisation and Global Interoperability - Final Report

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Abstract

This document is the final version of the deliverable (D07.02) out of the activities in task WA7 (AeroMACS Standardisation and Global Interoperability) of SESAR project P15.02.07 and describes the contributions made by the project partners to support the AeroMACS standardisation activities in the various standardisation bodies such as ICAO, EUROCAE, RTCA, AEEC and the WiMAX FORUM.

The deliverable D07.02 is based on the Interim Standardisation Report (Deliverable D07.01) and it captures the additional contributions made since the submission of the Interim Report in October 2013.

In addition, D07.02 identifies the relevant standardisation work that will be continuing after the formal end of the P15.02.07 WA7 activities.

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Executive summary

This document is the final version of the deliverable (D07.02) out of the activities in task WA7 (AeroMACS Standardisation and Global Interoperability) of SESAR project P15.02.07 and describes the contributions made by the project partners to support the AeroMACS standardisation activities in the various standardisation bodies such as ICAO, EUROCAE, RTCA, AEEC and the WiMAX FORUM.

The deliverable D07.02 is based on the Interim Report (Deliverable D07.01) and it captures the additional contributions made since the submission of the Interim Report in October 2013. In addition, D07.02 identifies the relevant standardisation work that will continue at the end of the P15.02.07 WA7 activities.

These contributions took place in the context of project P15.02.07 WA7, which has been the instrument for the two SESAR AeroMACS projects (P15.02.07 and P9.16) to support the development of the required aviation technical standards for AeroMACS.

Strong coordination with the US in the framework of Coordination Plan 4.4 [1] of the Coordination Agreement between US and EU, as well as with other key parties such as WiMAX Forum (WMF), has been an essential part and focus of the activities in task WA7 of the SESAR AeroMACS projects. Within the context of the AeroMACS standardisation work, dedicated groups have been established to guarantee global interoperability for all aspects of AeroMACS. The key groups established include ICAO WGS, EUROCAE WG-82, RTCA SC-223, AEEC/SAI AeroMACS Working Group, and WMF Aviation Working Group (AWG). The D07.02 deliverable summarises the key P15.02.07 contributions to each of these groups.

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1 Introduction

1.1 Purpose of the document

This document provides an overview of work performed in the context of the two SESAR AeroMACS projects (P9.16 and P15.02.07) and in particular within the P15.02.07 WA7: 'AeroMACS Standardisation and Worldwide Interoperability' work area. A selection of some key papers and contributions is attached covering primarily the material and contributions provided to various international standardisation bodies involved in the standardisation of AeroMACS.

1.2 Intended readership

This document is intended to provide a summary and high level record of the work performed in the SESAR AeroMACS activities to support the AeroMACS standardisation in the various relevant groups.

Parties interested in the AeroMACS standardisation process will find this document useful as it identifies the groups involved and provides a record of the various SESAR contributions for the various AeroMACS standards.

1.3 Inputs from other projects

1.3.1 FP7 SANDRA

Close cooperation between European Commission FP7 SANDRA project and SESAR 15.02.07 project has taken place in the early phases of the SESAR project and until the completion of SANDRA activities in 2013. This cooperation has resulted in some joint standardisation contributions, in particular covering the PHY layer definition as well as simulation activities which were used to progress work of both projects.

1.4 Acronyms and Terminology

Term	Definition
ACP	Aeronautical Communications Panel (ICAO) is the predecessor of the ICAO Communications Panel (COM Panel, CP) which was established in December 2014. The ICAO AeroMACS group (WGS) was a subgroup of ACP and now of CP
AEEC	Airlines Electronic Engineering Committee
AeroMACS	Aeronautical Mobile Airport Communications System
APIM (AEEC)	ARINC Project Initiation / Modification: A justified proposal for the AEEC Executive Committee to initiate the development of a new (or modify an existing one) ARINC standard
ASN	Access Service Network
ATM	Air Traffic Management

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Term	Definition
AWG	Aviation Working Group (a WMF working group dedicated to AeroMACS)
BS	Base station
COM Panel, CP	Communications Panel (ICAO). COM Panel is the successor of the ICAO ACP and has taken over since December 2014 the responsibility in ICAO for the AeroMACS activities (including overseeing of WGS).
CRSL	Certification Requirement Status List (WiMAX Forum [®])
CWG	Communications Working Group (a WMF working group)
E-ATMS	European Air Traffic Management System
EUROCAE	European Organisation for Civil Aviation Equipment
FAA	Federal Aviation Authority (United States)
FRAC	Final Review and Comment (RTCA document approval process)
ICAO	International Civil Aviation Organisation
MASPS	Minimum Aviation System Performance Specifications
MIB	Management Information Base
MOPS	Minimum Operational Performance Standards
MS	Mobile station
OC	Open Consultation (EUROCAE document approval process)
PICS	Protocol Implementation Conformance Statement (WiMAX Forum [®])
RTCA	Radio Technical Commission for Aeronautics
SAI	Systems Architecture and Interfaces (an AEEC subcommittee overseeing the development of Avionics standards)
SANDRA	Seamless Aeronautical Networking through integration of Data-links Radios and Antennas
SARPs	Standards And Recommended Practices
SRD	System Requirements Document
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.

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Term	Definition
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
TWG	Technical Working Group (a WiMAX Forum [®] working group)
WG	Working Group
WGS	Working Group Surface (ICAO COM Panel)
WMF	WiMAX Forum [®]

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2 STANDARDISATION ACTIVITIES

Standardisation activities for AeroMACS have been taking place in a number of groups. The SESAR contributions to these different AeroMACS groups have been the key factor in achieving high quality AeroMACS standards and specifications. Within the WA7 activities, such contributions have been coordinated not only between SESAR partners, but also between the different interested parties internationally and in particular US and Japan, in order to ensure the developed standards support global and interoperable AeroMACS systems. In particular there has been close coordination with the SANDRA FP7 project (finished in end of 2013) and there is continuing coordination with US/FAA.

The standardisation bodies and the documents to which SESAR projects P15.02.07 and P9.16 have contributed are identified below:

- ICAO COM Panel (ex ACP)
 - WGS development of:
 - AeroMACS SARPS
 - AeroMACS Technical Manual

- EUROCAE / RTCA
 - EUROCAE WG-82 and RTCA SC-223 collaboration to jointly develop:
 - AeroMACS Profile
 - AeroMACS MOPS
 - EUROCAE WG-82 development of:
 - AeroMACS MASPS

- WiMAX Forum
 - AWG development of:
 - PICS
 - CRSL
 - Security proposal (PKI)
 - Certification scenarios

- ARINC AEEC
 - SAI development of
 - APIM for AeroMACS
 - AeroMACS Working group development of:
 - Form Fit and Function (FFF) avionics standard

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2.1 P15.02.07 contributions to standardisation

As identified above, P15.02.07 has been closely related to standardization activities providing inputs and active support to different groups. The table below summarizes the key contributions to the various standardization bodies:

Standardization body	Description	Key achievements, outcome and future work
ICAO	ACP and CP CP WGS	<ul style="list-style-type: none"> Project was active contributor to the development of AeroMACS documents Active support and representation at the ICAO WGS meetings Key milestone was the contribution to the SARPS Validation that ended with the SARPS approval by ANC in October 2015. Ongoing work includes the completion of the development of the AeroMACS Technical Manual expected for Q2/Q3 2016
EUROCAE RTCA	EUROCAE WG-82 RTCA SC-223	<ul style="list-style-type: none"> Active support and representation of the European side at EUROCAE/RTCA meetings Key milestones achieved were the development of: <ul style="list-style-type: none"> ED-222 Aeronautical Mobile Airport Communication System (AeroMACS) Profile ED-223 Minimum Operational Performance Standards (MOPS) for the Aeronautical Mobile Airport Communication System Some initial work for a future revision of AeroMACS MOPS and Profile (at EUROCAE WG82 level at this stage)
EUROCAE	EUROCAE WG-82	<ul style="list-style-type: none"> Active contributions of P15.02.07 partners in EUROCAE WG-82 activities Key milestone was the development of the Minimum Aviation System Performance Standards (MASPS) for the Aeronautical Mobile

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		<p>Airport Communication System</p> <ul style="list-style-type: none"> Ongoing work is alignment of MASPS with draft ICAO Manual and publication of MASPS is expected in Q2/Q3 2016.
WiMAX Forum	AeroMACS AWG (Aviation Working Group)	<ul style="list-style-type: none"> Representation of the European side at WiMAX Forum, including active support in AeroMACS related events and dissemination of results into the WiMAX community Support to AWG group discussions PICS and CRSL documents were developed with support of SESAR AeroMACS projects Support to security discussions and PKI considerations for AeromACS. Support to certification and testing events (e.g. Vancouver 2015)
ARINC	AEEC SAI	<ul style="list-style-type: none"> Representation of the European side at SAI meetings with active participation and dissemination of SESAR project results Development and Submission of the AeroMACS APIM resulting in the launch of the AEEC SAI AeroMACS subgroup in 2014. Support to the activities of the AeroMACS subgroup and contributions to the avionics strawman for the AeroMACS Form Fit and Function (FFF) standard (ARINC Project Paper 766).

The P15.02.07 WA7: “AeroMACS Standardisation and Worldwide Interoperability” activity has relied mainly on other P15.02.07 Work Areas outputs and deliverables as well as the P9.16 outputs deliverables. Technical content, recommendations and conclusions from the deliverables of these projects have been used as input for standardisation activities covered by WA7 and discussed in the appropriate forums.

In particular, some of the work areas (WA1, WA2, WA3, WA4 and WA8) deliverables have been used to provide direct contributions to standardisation, while other work areas (WA5 and WA6) have contributed to the validation of the AeroMACS specifications and standards. An overview of the deliverables produced by the WA1, WA2, WA3, WA4, WA5, WA6 and WA8 P15.02.07 work areas are provided hereafter:

2.1.1 WA1 – Overall IEEE 802.16e-aero System Analysis and Design [2]

There were 5 documents out of WA1 and they were inputs to standardization bodies (mainly EUROCAE WG82) and the initial system requirements were inputs to subsequent Work Areas of P15.02.07. There were 5 deliverables out of WA1 as described below:

T1.1A: IEEE 802.16-2009 system analysis for AeroMACS use

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Provided an analysis of the suitability of the proposed IEEE 802.16 (WiMAX) standard for airport surface communication purposes, including aspects that would need specific adaptations for aviation.

T1.1B: AeroMACS System Requirements Document

Specified the sets of general, functional, performance and operational requirements that an aeronautical mobile airport surface communications system should comply with. It laid the foundation for specifying a dedicated profile for AeroMACS and defining required aviation specific requirements for standardisation activities.

T1.2 + T1.3: AeroMACS Profile Analysis

Provided a thorough analysis of current Mobile WiMAX System Profile and its suitability for deriving the future AeroMACS System Profile. It contained a detailed list of recommendations on the mandatory or optional use of every profile item, having addressed specific interoperability capabilities in coordination with EUROCA WG-82 and RTCA SC-223.

T1.4: AeroMACS Functional Architecture Definition

Described the preliminary architecture of the AeroMACS network pointing out all the fundamental components necessary to deploy for the AeroMACS networks to work. This covers requirements, deployment scenarios and ASN Business Profile.

T1.5: Spectral Investigations

Performed compatibility studies to assess potential interferences between the AeroMACS system and other systems operating in the same band or in adjacent bands.

2.1.2 WA2 – Channel models and propagation analysis [3]

There were 3 documents out of WA2 and results of the modelling and simulations were used in the development of the AeroMACS Profile (WA3) and were also inputs to standardization bodies.

T2.1: Airport Surface Channel Modelling

Conducted channel measurements at Barajas airport. The main purpose of the measurements was to provide realistic signal propagation data from an airport environment. Channel and propagation parameters were modelled and have served as input for the AeroMACS system profile. Activity coordinated with the SANDRA project.

T2.2: Study and characterization of the traffic model in the airport

Assessed and modelled the AeroMACS system from the perspective of the services it might support. Performed simulations provided an estimation of the real traffic pattern AeroMACS should support in future hypothetical deployments. Activity coordinated with the SANDRA project.

T2.3: Compatibility study between AeroMACS and FSS

Presented results from simulations of the potential interference level AeroMACS installations in Europe may induce to Globalstar satellites, and compared to the criterion from ITU.

2.1.3 WA3 – IEEE 802.16e-aero Profile [4]

There were 2 documents out of WA3 with main outcome the definition of the AeroMACS profile and its initial validation through simulations. The output of WA3 was an important input to EUROCAE WG82/RTCA SC-223 for the standardization of the AeroMACS profile. AeroMACS profile is now also an input to WMFAWG for the ongoing definition of IOT tests to certify AeroMACS products based on

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the model developed for the certification of the WiMAX products. This certification process is currently under definition at WMF and is expected to be completed beyond the closure of P15.02.07.

T3.1: AeroMACS Profile Evaluation and Validation

Performed simulations and analysis to validate the profile items selection defined in WA1 and to provide results that can support the choice between different profile options.

T3.2: AeroMACS Profile Definition

Described the proposed AeroMACS profile definition, specifying item by item its inclusion or not in the AeroMACS profile and provided the basis for the EUROCAE/RTCA jointly approved final AeroMACS profile.

2.1.4 WA4 – Deployment and Integration Analysis [5]

The outcome of WA4 addressed the deployment of AeroMACS at the airport surface and provided general guidelines on how to deploy AeroMACS at the airport surface, covering aspects such as cell planning interference, integration with ATM network and interoperability. Cell planning analysis for Toulouse and Madrid-Barajas airport deployments were undertaken and propagation simulations were compared against real measurements obtained during the live trials at Toulouse airport to confirm the accuracy and validity of the simulations. The outcome of this work was provided to standardization bodies and is used in particular in the context of the AeroMACS MASPS.

2.1.5 WA8 – Security and Safety Analysis [6]

There were 2 documents out of WA8 analysing the safety and performance requirements following the EUROCAE WG-78/RTCA SC-214 methodology as well as the security issues related to the WiMAX protocol, including risk assessment of vulnerabilities. The WA8 outcome was provided to standardisation bodies (ICAO, EUROCAE) and provided the basis for guidance material to secure AeroMACS infrastructure to be considered during system standardization and implementation phases.

T8.1: AeroMACS Safety and Performance Analysis

Performed an analysis of safety and performances requirements which could be applicable to the AeroMACS system as an enabler for ATC related Datalink services.

T8.2: AeroMACS Security Analysis

Assessed the AeroMACS security risks and potential resulting requirements.

2.1.6 WA5 – AeroMACS Prototypes Description and Verification Strategy

The WA5 outcome was split in two parts. Part 1 describes the Thales and SELEX AeroMACS Ground Prototypes used during tests and in particular, it details the IEEE 802.16/aero standard as framework to indicate the prototype features and covers the prototype installation and setup. Part 2 describes the overall AeroMACS Verification Strategy, including testing scenarios and it details the individual Verification Objectives that served as input to the P15.02.07 Verification Plan. WA5 with the development of the AeroMACS prototypes and the AeroMACS Verification Strategy enabled WA6 to address the AeroMACS Integration and Testing activities in SESAR.

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2.1.7 WA6 – AeroMACS Verification Plan & Report – Phase 1 and Phase 2

The WA6 outcome was split in two phases and is covered by two separate deliverables. Phase 1 deliverable (D06) covers the initial testing campaign and Phase 2 deliverable (D10) covers the final testing campaign and covered laboratory and airport testing. The outcome of WA6 was instrumental in the validation of the AeroMACS specifications and together with the P9.16 testing reports provided crucial contributions for the SARPS validation and approval at ICAO. The outcome of WA6 will also be considered in the refinement of the AeroMACS Profile and future updates of AeroMACS MOPS in EUROCAE and RTCA.

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3 ICAO CONTRIBUTIONS

ICAO COM (Communications) Panel (ex ACP) is responsible for the development of the Standards and Recommended Practices (SARPs), as well as guidance material for air-ground and ground-ground aeronautical communications, both voice and data.

Within the COM Panel, WG Surface (WG-S) is the group dealing with airport surface datalink development, and has undertaken the development of the ICAO SARPs and now is working for the development of the Technical Manual for AeroMACS.

The main goal of these ICAO activities is to guarantee that AeroMACS equipment is interoperable at a global level.

3.1 AeroMACS SARPs

Standards and Recommended Practices deal with a wide range of matters concerned with the safety, regularity and efficiency of air navigation.

The AeroMACS SARPs is a set of high level requirements focusing on the AeroMACS “signal in space” and defining the key AeroMACS system requirements. The SARPs include spectrum requirements such as operation band, radiated power and spectrum mask. The SARPs are applied universally and produce a high degree of technical uniformity.

The AeroMACS SARPs were developed by WGS and approved by the COM Panel in December 2014 and the ICAO Air Navigation Commission (ANC) in March 2015 approved the SARPs for a State letter process. In October 2015, ICAO ANC provided the final approval of the SARPs with an applicability date of November 2016.

The approval of the SARPs was enabled based on the input coming in particular from the testing reports and outcome of the two SESAR AeroMACS projects P15.02.07 and P9.16. EUROCONTROL on behalf of the SESAR partners was the editor of the ICAO SARPs AeroMACS validation report which summarised the various validation activities and provided the evidence for the completion of the validation.

The AeroMACS SARPs, will now be published and included in ICAO Annex 10 Volume III: Digital Data Communication Systems and Voice Communications Systems [8].

ICAO	
Title:	Aeronautical Mobile Airport Communication System (AeroMACS) SARPs, Annex 10 Vol III
Publication:	November 2016
Status:	Approved – awaiting publication

3.2 AeroMACS Manual

The objective of the AeroMACS (Technical) Manual is to provide guidance on the consideration of AeroMACS as a platform to support applications and services at the airport surface. This guidance material will include concept of operations, system architecture and implementation aspects.

Following the approval of the AeroMACS SARPs, WGS is now focusing on the development of the AeroMACS Manual. A complete draft is available and the group continues to work through webexes and physical meetings aiming to finalise the Manual by Q2/Q3 2016 in time for the SARPs applicability date of November 2016.

The AeroMACS Manual (like all Manuals in ICAO) will be published under the authority of the ICAO Secretary General and therefore it does not require State Letter approval process.

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ICAO	
Title:	DOC10044: AeroMACS Manual
Publication:	Q3 2016 (expected)
Status:	Draft

3.3 Meetings

ICAO CP (and ACP before) WGS has conducted eight physical meetings up to now and the 9th meeting is taking place from the 29th February to 3rd March 2016.

Meeting	Date	Status	Location	Remark
Kick-off	19-20/03/2012	Held	Montreal (Canada)	
#2	23-25/03/2012	Held	Montreal (Canada)	
#3	08-09/06/2013	Held	Montreal (Canada)	
#4	15-16/10/2013	Held	Montreal (Canada)	
#5	14-15/07/2014	Held	Montreal (Canada)	
#6	13-14/11/2014	Held	Sendai (Canada)	Approval of Draft SARPs
#7	22-23/06/2015	Held	Montreal (Canada)	
#8	08-11/12/2015	Held	Montreal (Canada)	
#9	29/02- 02/03/2016	Planned	Montreal (Canada)	
#10	Q2/Q3 2016	Planned	Montreal (Canada)	Final WGS Meeting to approve Manual

Table 1a: ICAO CP WGS Meetings

In addition WGS has conducted regular webexes to progress the work in particular of the manual following the approval of the AeroMACS SARP.

ICAO COM Panel (ex ACP) has conducted two meetings up to now.

Meeting	Date	Status	Location	Remark
Kick-off	01-05/12/2014	Held	Montreal (Canada)	Approval of WGS proposed SARPs
CP/CWG	28/02-03/10/2015	Held	Montreal (Canada)	

Table 2b: ICAO COM Panel Meetings

4 EUROCAE WG-82 / RTCA SC-223 CONTRIBUTIONS

4.1 INTRODUCTION

EUROCAE and RTCA are the respective European and United States standardisation bodies involved in the standardisation of avionics equipment. Since RTCA or EUROCAE are not government agencies either in US or Europe, their recommendations are not binding unless referenced in an appropriate regulation.

EUROCAE WG-82 has been established to develop the appropriate standards related to the new air-ground data link technologies including data links for airport surface and En Route/TMA using terrestrial and satellite communications. So far it is mainly the airport surface datalink activities that have been pursued and recently the group started considering the SATCOM datalinks. For AeroMACS the work was based on WIMAX (IEEE 802.16) and in this context, partnership and collaboration with RTCA SC-223 has actively taken place.

Because both organisations have a similar purpose, they often – when common interest/goals exist – team up and form joint groups working in very close co-ordination in order to publish common avionics standards. Because both the US and Europe have shared interest in developing a common airport surface datalink system, AeroMACS Profile and Minimum Operational Performance Specification (MOPS) have been developed in close co-operation between EUROCAE WG-82 and RTCA SC-223.

These documents have been jointly developed through a consensus process and have been accepted by the Council of EUROCAE and RTCA Program Management Committee in 2014. Hence the development of common standards has taken place, although they have been published under separate reference numbers and covers.

EUROCAE WG-82 is also specifying the end to end system requirements and therefore is also developing and will publish the AeroMACS Minimum Aviation System Performance Specifications (MASPS).

The draft AeroMACS MASPS have completed the EUROCAE Open Consultation (OC) process in the end of 2015 and are now ready for publication. However it was agreed to delay the publication to Q2/Q3 2016 to allow for a final review to fully align with ICAO AeroMACS Manual.

4.2 AeroMACS Profile

The AeroMACS Profile document identifies a unique subset of the features in the current IEEE 802.16-2009 standard [11] as well as where necessary any specific adaptations to the current standard to support the aviation requirements and provide wireless data communications capability to mobile and fixed platforms on an airport surface.

This ensures that all stakeholders comprising test equipment vendors, integrated circuit manufacturers, as well as the aviation industry are capable of supporting the AeroMACS development in an interoperable way.

For the preparation of this document it has been investigated the use of WiMAX Forum[®] Mobile System Profile [12] against avionics needs. In the context of the SESAR project P15.02.07 activities, analysis of the AeroMACS features has been performed in WA1 and WA3 and the outcome of these activities has been injected in the development of the AeroMACS profile.

EUROCAE	
Title:	ED-222: Aeronautical Mobile Airport Communication System (AeroMACS) profile
Publication:	November 2013
Status:	Available
RTCA	

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Title:	DO-345: Aeronautical Mobile Airport Communications System (AeroMACS) Profile
Publication:	December 2013
Status:	Available

4.3 AeroMACS MOPS

This document contains the recommended Minimum Operational Performance Standards for both the Airborne Component (Mobile Station, MS) and Ground Based station (Base Station, BS) of AeroMACS system.

It defines System characteristics that should be useful to designers, manufacturers, installers and users of the equipment. Compliance with this standard is recommended as one means of assuring that the equipment will perform its intended function(s) satisfactorily under all conditions normally encountered in routine aeronautical operation.

It is important to note that RTCA is, in general, not developing MOPS for ground systems, whereas EUROCAE may develop MOPS for both ground and airborne systems. While for AeroMACS a joint document covering both systems has been developed by RTCA/EUROCAE, FAA is not required to use the RTCA MOPS for Ground Systems.

EUROCAE	
Title:	ED-223: Minimum Operational Performance Standards (MOPS) for the Aeronautical Mobile Airport Communication System
Publication:	October 2013
Status:	Available
RTCA	
Title:	DO-346: Minimum Operational Performance Standards (MOPS) for the Aeronautical Mobile Airport Communication System (AeroMACS)
Publication:	February 2014
Status:	Available

4.4 AeroMACS MASPS

This document contains the recommended Minimum Aviation System Performance Specification (MASPS) for AeroMACS. This specification is intended for designers, manufacturers, installers of avionics equipment, service providers and users of these systems.

The MASPS includes functional requirements as well as performance requirements. Guidance for the development and deployment of AeroMACS systems is provided, including specifications about system architecture, QoS and Security.

In addition, it is envisaged that the MASPS include a summary of necessary end-to-end tests cases to guarantee interoperability.

EUROCAE	
Title:	ED-227: Minimum Aviation System Performance Standards (MASPS) for the Aeronautical Mobile Airport Communication System
Publication:	Q2/Q3 2016 (expected)
Status:	Open Consultation Process completed, awaiting publication

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4.5 Meetings

EUROCAE WG-82 has conducted fourteen meetings up to now, all of which have been attended by P15.02.07 partners. Seven of these meetings were joint meetings with RTCA SC-223 and most of the joint meetings held in the US have been attended by EUROCONTROL (as WA7 activity leader) in line with SESAR mission requirements and according to SJU approval procedures. The following table gives an overview of the meetings held and planned.

Meeting	Date	Status	Location	Remark
Kick-off	14/01/2010	Held	Paris (France)	Combined meeting with SESAR 15.02.07
#2	8-9/03/2010	Held	Langen (Germany)	Combined meeting with SESAR 15.02.07
#3	28-30/09/2010	Held	Brussels (Belgium)	Combined meeting with SESAR P15.02.07 and RTCA SC-223
#4	25-26/01/2011	Held	Madrid (Spain)	Combined meeting with SESAR 15.02.07
#5	03-05/05/2011	Held	Washington (USA)	Combined meeting with RTCA SC-223
#6	24-25/05/2011	Held	Brussels (Belgium)	Combined meeting with SESAR 15.02.07
#7	11-13/10/2011	Held	Langen (Germany)	Combined meeting with SESAR P15.02.07 and RTCA SC-223
#8	27-28/03/2012	Held	Madrid (Spain)	Combined meeting with SESAR 15.02.07
#9	18-19/04/2012	Held	Melbourne (USA)	Combined meeting with RTCA SC-223
#10	24-25/07/2012	Held	Washington (USA)	Combined meeting with RTCA SC-223
#11	02-03/10/2012	Held	Washington (USA)	Combined meeting with RTCA SC-223
#12	19-20/02/2013	Held	Brussels (Belgium)	Combined meeting with SESAR P15.02.07
#13	09-11/04/2013	Held	Paris (France)	Combined meeting with SESAR P15.02.07
#14	26-28/06/2013	Held	Brussels (Belgium)	Combined meeting with SESAR P15.02.07 and RTCA SC-223
#15	01-02/10/2013	Held	Toulouse (France)	Combined meeting with SESAR P15.02.07 and P9.16
#16	11-12/02/2014	Held	Gennevilliers/Paris (France)	Combined meeting with SESAR P15.02.07 and P9.16
#17	13/05/2014	Held	Brussels (Belgium)	Combined meeting with SESAR P15.02.07 and P9.16
#19	07-08/10/2014	Held	Toulouse (France)	Combined meeting with SESAR P15.02.07 and P9.16
#21	11-12/02/2015	Held	Brussels (Belgium)	Combined meeting with SESAR P15.02.07 and P9.16
webex	30/10/2015	Held	webex	Resolution of OC process

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				comments for MASPS
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Table 3: EUROCAE WG-82 and RTCA SC-223 AeroMACS Meetings

Note: Since 2014, EUROCAE WG82 is also addressing SATCOM aspects through dedicated meetings (such #18 and #20) not covered in the above table. Since the resolution webex of the OC MASPS comments WG82 (on 30th October 2015), WG-82 is addressing only SATCOM aspects.

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5 WIMAX FORUM AVIATION WORKING GROUP CONTRIBUTIONS

WiMAX Forum® (WMF) is an industry organisation having as purpose to ensure worldwide interoperability between WiMAX products. Hence the WMF organises WiMAX worldwide interoperability product testing by ensuring the availability of specialised 'WiMAX certification laboratories' in various places.

AeroMACS is based on the existing IEEE 802.16-2009 WiMAX standard [11]. Within the WiMAX Forum®, an Aviation Working Group (AWG) has been established to adapt AeroMACS requirements into the WiMAX profile documents. AWG acts as a liaison between WiMAX Forum® members and SESAR partners as well as other members of aviation community.

This ensures that all stakeholders comprising test equipment vendors, integrated circuit manufacturers, as well as the aviation industry are capable of supporting the AeroMACS development.

In addition, the Protocol Implementation Conformance Statement (PICS) [13] and Certification Requirements Status List (CRSL) [14] documents are required to provide equipment manufacturers with detailed reference on how to apply WiMAX standard to develop AeroMACS products. They have been produced by AT4WIRELESS under contract to EUROCONTROL and delivered to the WiMAX Forum®.

Analysis of the AeroMACS features performed in the context of the SESAR project P15.02.07 activities and the outcome of these activities has been injected in the finalization of these PICS and CRSL documents.

A memorandum of understanding has been signed between EUROCAE, RTCA and WiMAX Forum® to define the process that should be followed to maintain AeroMACS related standards by the respective organizations.

In addition AWG has been addressing other items of interest for AeroMACS such as security considerations (PKI), the development of certification scenarios and support to testing campaigns with contributions from the SESAR project partners.

5.1 AeroMACS PICS

The PICS is a checklist of the capabilities supported by an implementation under analysis, in the form of a questionnaire. Its purpose is to specify the list of protocol elements required as realization of WiMAX Forum® Mobile System Profile [12] based on the WiMAX Forum® Standard Reference [11]. PICS proforma is also a mechanism whereby a supplier of an implementation of the requirements may provide information about the implementation in a standardized manner.

In order to provide certification means for WiMAX equipment, WMF is developing a set of test requirements known as certification tracks. So far there is only one certification track available: Open Retail 1a (OR1a). AeroMACS PICS is almost equivalent to OR1a WiMAX certification track due to COTS consideration.

However, AeroMACS has excluded features from the WiMAX system specification as well as adopted new features which are not included in WiMAX specification.

The draft AeroMACS PICS were developed by AT4W under contract to EUROCONTROL and provided to WIMAX Forum for discussion and approval.

The AeroMACS PICS have been approved by the TWG (Technical Working Group) and it has been jointly decided by AWG (Aviation Working Group) and TWG to assign a unique document ID to AeroMACS PICS (i.e. AeroMACS PICS will be maintained separately from WiMAX PICS). The AeroMACS PICS are now available.

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Title:	T24-003-R010v01: WiMAX Forum® AeroMACS Protocol Implementation Conformance Statement (PICS) Proforma
Publication:	November 2013
Status:	Available

5.2 AeroMACS CRSL

The AeroMACS Certification Requirement Status List (CRSL) contains the complete set of required testing to certify AeroMACS systems. It includes Protocol conformance (PCT), Radio Conformance (RCT), Network Conformance (NCT), Radio Regulatory (RRT), Mobile Interoperability (MIOT), & Operator Interoperability.

In order to provide certification means for WiMAX equipment, WMF is developing a set of test requirements known as certification tracks. So far there is only one certification track available: Open Retail 1a (OR1a). AeroMACS CRSL is almost equivalent to OR1a WiMAX certification track due to COTS consideration.

However, AeroMACS has excluded features from the WiMAX system specification as well as adopted new features which are not included in WiMAX specification.

The AeroMACS CRSL identifies the WiMAX Forum® lead profile test cases which are required or not for AeroMACS. It covers all the test cases in the WiMAX CRSL (i.e. those test cases presently required for AeroMACS certification and those which are not, including the supporting rationale).

The draft AeroMACS CRSL was developed by AT4W under contract to EUROCONTROL and provided to WiMAX Forum groups for discussion and approval.

The AeroMACS CRSL has been approved by the WiMAX CWG (Communication Working Group) and it has been jointly decided by AWG (Aviation Working Group) and CWG that the AeroMACS CRSL Profile will be included in the WiMAX CSRL.

AWG has continued working on the AeroMACS certification aspects and discussions are ongoing in AWG for potential improvements and updates

WiMAX Forum®	
Title:	WiMAX Forum® AeroMACS Certification Requirement Status List (CRSL)
Publication:	Q1 2014
Status:	Available

5.3 Additional AeroMACS test procedures

There are some features to be supported by AeroMACS, like IPv6 or multicast, which have not yet been included in AeroMACS standards due to the lack of a WMF certification means. The only WiMAX certification track available so far is OR1a, which does not provide test procedures for these features.

As these features are important for aviation and AeroMACS, in the context of WA7 activities AT4W under contract to EUROCONTROL developed proposals for the required additional certification test procedures proposals and these were provided to WiMAX Forum and EIROCAE/RTCA for inclusion as required possibly in a new certification track (i.e OR1b or other).

5.4 Other WiMAX Forum AWG activities

In addition to the AeroMACS PICS and CSRL, AWG also addressed certification and security aspect of AeroMACS.

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For certification, a dedicated AWG subgroup developed certification scenarios and is now also discussing the evolution of the CSRL material. The scenarios were used in a testing campaign organised by WMF in September 2015 with participation from manufacturing industry. A SESAR partner (SELEX) has participated in this session.

For security, AWG established a dedicated subgroup (Public Key Infrastructure – PKI subgroup) which is developing a proposal for a PKI certificate policy to be used for AeroMACS as well as the security management services to be supported by AeroMACS. The AWG/PKI subgroup is actively coordinating with ICAO WGS and the aim is to agree on a policy that will be valid for AeroMACS as well as for the other new FCI links (LDACS and Long Term SATCOM).

5.5 WiMAX Forum Meetings

WiMAX Forum® AWG meetings have taken place mostly by webex, and with F2F opportunities during WMF Member Conferences (such as the WMF Member Conference in September 2013 in USA in which an AWG meeting was held to proceed with the approval of the PICS and CRSL).

WMF has held various events focusing on AeroMACS and promoting its usage. In September 2013 the first WMF AeroMACS summit took place in Washington DC in US and this was followed by a European AeroMACS summit in May 2014 in Brussels, a China event in Beijing in September 2014 and a Japan event in Sendai in November 2014. In 2015, WMF hosted events in Madrid in March and in US in October. The key aim of these events is to increase awareness about AeroMACS among the WiMAX industry and provide better understanding of the aviation requirements and market aspects.

SJU, EUROCONTROL management and the SESAR partners participated in these events and providing input and contributions. As an example, the input to the first event in September 2013 involved SJU, EUROCONTROL, Airbus, Thales, Selex ES, INDRA and SITA. The European (and other) presentations in this event are available in [15].

For 2016, WMF is organising an AeroMACS webinar on the 30th of March 2016, in which EUROCONTROL will be presenting together with FAA AeroMACS industry and WMF representatives. Additional info for the event is available at:

<http://www.wimaxforum.org/event/webinar-expect-enormous-changes-in-aviation-performance-with-certified-aeromacs>

6 ARINC AEEC SAI and AeroMACS subgroup

The Airlines Electronic Engineering Committee (AEEC) creates value for airlines and the aviation industry by developing engineering standards and technical solutions for avionics, networks, and cabin systems that foster increased efficiency and reduced life cycle costs throughout the aviation community.

ARINC (AEEC) Standards, developed and adopted by AEEC are critical for the airlines and aviation industry and are required to support deployment decisions and planning.

AEEC is providing in particular a forum, the Data Link Users Forum (DLUF), to discuss items in relation to current as well as future data links. The DLUF is a coordinating activity among airlines, cargo carriers, aircraft manufacturers, avionics manufacturers, and data link service providers on technical issues of mutual interest leading to the identification and resolution of common problems. The DLUF also provides an opportunity for coordination among airlines, civil aviation authorities, and air traffic service providers on the direction and schedule of new Air Traffic Service (ATS) data link programs.

There has been participation in a number AEEC DLUF meetings (such as in September 2012 DLUF meeting), providing information and updates on the SESAR AeroMACS activities to raise the awareness, in particular, of the Airline Community.

In addition, in order to support the discussions in the AEEC to establish a group to develop the required Form Fit and Function (FFF) documents for AeroMACS, a draft APIM (AEEC Project Initiation/Modification) document was developed and presented in various AEEC SAI meetings. The AeroMACS APIM (APIM 11-013A) was finally approved in 2014 and is provided for information in Appendix B.

With the APIM 11-013A, it was agreed that the work within the AEEC will be undertaken in two steps. In the first step (step 1) the primary objective was to undertake a preliminary analysis, in particular, for the desired airborne architecture meeting in an evolving manner the airline needs. The key outcome of step 1 was the agreement to establish a dedicated AeroMACS subgroup (under SAI) which is now developing the strawman for the AeroMACS ARINC standard (ARINC Project Paper 766).

The AeroMACS AEEC subgroup has had so far (February 2016) 2 physical meetings and monthly webexes to progress the development the avionics standard for the AeroMACS Radio Unit (ARU). ARU is specified as a modem (on-board radio) connecting the aircraft to the AeroMACS ground network. Currently a definition of the ARU Physical Interfaces and specification is proposed and different ARU packages as well as the ARU Antenna performance and mounting requirements are under discussion in the AeroMACS group. A new physical meeting is planned for May to further develop the draft standard and address open issues and the standard will likely be completed by end of 2016.

Although AeroMACS is designed for IP, as the IP networking in AEEC is now being progressed and will not be completed in the near future, the AeroMACS draft standard is expected to consider support for ATN over IP and even ACARS over IP to provide benefits for early implementations.

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7 DELIVERABLES FROM CONTRACTS

In the context of WA7 activities, the Task Leader EUROCONTROL established two contracts with external entities to obtain the required expertise and support. In the following sections the key outcome under these two contracts are identified.

7.1 AT4WIRELESS

EUROCONTROL established in 2012 a contract with AT4Wireless in order to support the AeroMACS standardisation activities on the following subjects:

1. Development of WMF AeroMACS CRSL
2. Development of WMF AeroMACS PICS
3. Development of Technical notes for specific issues to support discussions in the AeroMACS standardisation groups (see Appendix A).
4. Provide Contributions to the WMF Aviation Working Group (AWG) activities and in particular the AeroMACS Certification Working Group.
5. Provide WIMAX standard expertise for the finalisation of AeroMACS documents in ICAO and EUROCAE/RTCA (including the development of validation tests for IPv6 and multicast features.)

7.2 ALOT Technologies

EUROCONTROL also established in 2013 a contract with Alot Technologies in order to support the AeroMACS standardisation activities, mainly on the following aspects:

1. Support the activities of the EUROCAE WG82 and RTCA SC223 (Profile, MOPS and MASPS)
2. Support the activities of the ICAO CP WGS (SARPs and Technical Manual)

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8 Future Standardisation Work (beyond end of P15.02.07)

While the SESAR projects provided significant and decisive contributions for the overall standardisation of AeroMACS, there are some activities that may be completed or even continue after the closure of the P15.02.07 project (planned for May 2016) and the WA7 task activities.

In ICAO, the AeroMACS manual will be completed in the Q2/Q3 timeframe

In EUROCAE and RTCA, updates of the MOPS and Profile will be considered in the future

In AEEC, the AeroMACS avionics standard will be completed in Q4 2016 or in 2017

In addition, discussions are ongoing for an ETSI standard and possibly an EASA activity.

All above standardisation relating activities will be considered as required, in the SESAR2020 expected activities in the context of solution PJ14-02-06 which is currently under definition.

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9 References

- [1] US – EU Coordination Plan 4.4
- [2] SESAR 15.02.07, Deliverable D01 - Overall IEEE 802.16e-aero System Analysis and Design
- [3] SESAR 15.02.07, Deliverable D02 - Channel models and propagation analysis
- [4] SESAR 15.02.07, Deliverable D03.1 - IEEE 802.16e-aero Profile
- [5] SESAR 15.02.07, Deliverable D04 - Deployment and Integration Analysis
- [6] SESAR 15.02.07, Deliverable D08 - Safety and Performance Analysis
- [7] SESAR 15.02.07, Deliverable D03.2 - AeroMACS System Requirements Document
- [8] ICAO Annex 10 Volume III: Digital Data Communication Systems and Voice Communications Systems
- [9] SESAR 15.02.07, Deliverable D05 - AeroMACS Prototypes Description and Verification Strategy
- [10] SESAR 15.02.07, Deliverable D06 - Verification Plan & Report
- [11] IEEE 802.16-2009, IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Broadband Wireless Access Systems, 2009
- [12] WiMAX Forum, Mobile WiMAX Release 1 System Profile (WMF-T23-001-R010v09), 2009
- [13] WiMAX Forum, AeroMACS Protocol Implementation Conformance Statement (PICS) Proforma, 2013
- [14] WiMAX Forum, AeroMACS Certification Requirement Status List (CRSL), 2013
- [15] http://www.wimaxforum.org/files/WiMAX_Forum_Events_2013/WiMAX%20Aviation%202013%20Presentations.pdf

Appendix A AT4WIRELESS Technical Notes

At the request of EUROCONTROL, AT4W developed 15 Technical Notes to support discussions in the various AeroMACS standardisation groups. The list of the technical notes is:

TN#1: IP addressing in AeroMACS

The goal of this technical note is to justify the exclusion of the “Secondary Management Connection ID” from the AeroMACS profile.

TN#2: Analysis of the use of MIB for aviation

The goal of this technical note is to justify the necessity of using standardized MIB for AeroMACS.

TN#3: Timer values for AeroMACS

The goal of this technical note is to analyse and propose acceptable timer values for AeroMACS profile.

TN#4: Testing coverage of center frequency

The goal of this technical note is to clarify the WiMAX certification testing coverage of the WiMAX systems capability of operating at the specified center frequency steps covering the whole frequency grid.

TN#5 : Security impact of multicast in AeroMACS

The goal of this technical note is to analyse the impact on security of implementing multicast and broadcast services in AeroMACS.

TN#6 : Dynamic range discussion in AeroMACS

Analyse the feasibility of increasing the coverage considering the BS transmitter dynamic range required by the IEEE 802.16-2009.

TN#7: Distance to avoid BER by interference

The goal of this technical note is to identify the minimum separation distance between WiMAX receivers and WiMAX adjacent channel interferers that ensures there is no BER degradation at the receivers.

TN#8: AeroMACS RCT Measurements

Indicate within all WiMAX Forum[®] RCT test cases what is applicable to AeroMACS taking into account the technical requirements of AeroMACS (e.g., TDD only, 5 MHz only, etc).

TN#9: AeroMACS susceptibility to Co-Channel

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The goal of this technical note is to identify the AeroMACS susceptibility to co-channel Interference or interference coming from other systems operating in the same 5 MHz frequency channel.

TN#10: WiMAX cert and AeroMACS specs gap

Gap analysis between the WiMAX Forum[®] certification coverage and the AeroMACS technical specification (Profile, PICS, and MOPS).

TN#11: MOPS Review #2

The goal of this technical note is to clarify some open issues linked to AeroMACS MOPS development which were brought up in RCTA/EUROCAE meeting in Madrid (2012-09-12).

TN#12: HO procedures supported by the WiMAX Forum[®]

This technical note describes at a high level the handover procedures certified by the WiMAX Forum[®] with the goal to help AeroMACS community to decide whether or not MOB_SCN-REQ is required by the AeroMACS certification profile.

TN#13: AeroMACS susceptibility to fading

The goal of this technical note is to provide a study on AeroMACS receiver susceptibility to fading scenarios, namely pedestrian and vehicular.

TN#14: SF Management and QoS in AeroMACS

The goal of this technical note is to answer the following two questions:

How does a high priority AeroMACS service running on the MS select a specific Service Flow as underlying MAC connection to send the traffic?

How are the AeroMACS service initiation and the SF activation linked?

TN#15: WiMAX certification gap for AeroMACS

This document analyses the gap for the missing test cases from the WiMAX Forum[®] certification to cover all the features adopted by AeroMACS.

TN#16: How AeroMACS can use IPv4 and IPv6 as specified in the AeroMACS MOPS

This document analyses the relevant MOPS requirements, reviews the network entry and connection establishment process in AeroMACS and describes the IP addressing management scheme for AeroMACS.

TN#17: IPv6 and Ethernet CS test cases specification for AeroMACS

This document provides specifications for IPV6 and Ethernet CS test cases for inclusion the AeroMACS MASPS.

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TN#18: Multicast and broadcast support in AeroMACS

This document analyses the current specifications in the AeroMACS standards (Profile and MOPS) for supporting multicast and broadcast applications and provides proposals for evolution for a more efficient support to broadcast and multicast applications in the future. In addition the document describes the required evolution/updates of the AeroMACS standards and provides test cases for the certification of the broadcast and multicast support.

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Appendix B AeroMACS APIM

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AEEC Project Initiation/Modification (APIM)

- 1.0 Name of Proposed Project** **APIM 11-013A**
AeroMACS Avionics Specification
- 1.1 Name of Originator and/or Organization**
Nikos Fistas / EUROCONTROL
Brent Phillips / FAA
- 2.0 Subcommittee Assignment and Project Support**
- 2.1 Suggested AEEC Group and Chairman**
It is proposed that the work within the AEEC will be undertaken in two steps.
The first step (step 1) will be within the SAI Subcommittee. The primary objective is to undertake a preliminary analysis, in particular, the desired airborne architecture meeting in an evolving manner the airline needs. A key outcome of step 1 will be the agreement on the way ahead for the AeroMACS avionics standard and will be essential to scope the standardization activity (to be carried in step 2) and identify the desired features in the ARINC Standard for AeroMACS.
Then, in step 2, use the foundation of step 1 to undertake the drafting of the AeroMACS specification in a dedicated group to be identified per the recommendation of the SAI Subcommittee.
- 2.2 Support for the activity (as verified)**
Airlines: American, FedEx, Southwest, TAP Portugal, United, UPS
Airframe Manufacturers: Airbus, Boeing
Suppliers: ACSS, Harris, Honeywell, Rockwell Collins, SELEX ES, Thales
Others: ASRI, EUROCONTROL, FAA, SITA (all TBC)
- 2.3 Commitment for Drafting and Meeting Participation (as verified)**
Airlines: United, UPS (others TBD)
Airframe Manufacturers: Airbus, Boeing [TBC]
Suppliers: Harris, Honeywell, Rockwell Collins, SELEX ES, Thales
Others: EUROCONTROL, FAA, SITA (all TBC)
- 2.4 Recommended Coordination with other groups**
EUROCAE WG-82, RTCA SC-223 and ICAO ACP/WGS
AEEC Subcommittees: as required AGCS, AOC, DLK, others TBD
- 3.0 Project Scope**
- 3.1 Description**
INTRODUCTION
AeroMACS (Airport Mobile Access Communication System) is one of the new data links proposed in the Future Communications Infrastructure (FCI) and is intended to support the future airport surface communications.
AeroMACS is identified in the ICAO COM roadmap and the ICAO Global Air

Navigation Capacity and Enhancement Plan (GANP) strategy (as a Block 2 element) and is scheduled to operate in protected AM(R)S spectrum. AeroMACS is designed to support both safety of life (Air Traffic Management, ATM) and regularity of flight (Aeronautical Operational Control, AOC) operations.

AeroMACS is based on the IEEE 802.16 standard (WiMAX) and will deliver an IP-based high data rate radio link, which will be used to support existing as well as enable future (advanced) aircraft-to-ground (ATS) and (AOC) services. In addition AeroMACS can enable and support SWIM type of services in the airport surface environment.

The AeroMACS protocols and features are covered in the AeroMACS profile which is a selected subset of the WiMAX and IEEE 802.16 standard providing the minimum requirements that are needed to support global interoperability. The AeroMACS profile has been jointly standardized in EUROCAE and RTCA and is also a recognized profile of the WiMAX commercial standard, aiming to facilitate the availability of equipment.

Furthermore, RTCA (SC-223) and EUROCAE (WG-82) have jointly developed AeroMACS Minimum Operational Performance Standards (MOPS) covering the ground and airborne side and EUROCAE is continuing now with the development of the AeroMACS Minimum Aviation System Performance Standards (MASPS).

Finally, ICAO ACP WGS is finalizing the AeroMACS SARPS and will also develop an AeroMACS Technical Manual.

The AEEC standardization effort is proposed to develop the required avionics specification to cover the items such as:

- Airborne transceiver form, fit, function, interface, definition capable of operating in the MLS Extension Band 5000 to 5150 MHz
- Avionics architecture
- Interfaces to airborne peripherals, i.e., control/display functions, central maintenance functions, etc. (Items to be considered are the need or not to identify aircraft network domain (ACD, AISD), message structure, specific equipment interfaces (CMU, ATSU, MCDU, etc.) and data destination management.)
- Integration with related broadband systems
- Segregation from unrelated functions
- Aircraft installation guidelines
- Antennas and cabling
- Others items [TBD]

The above list will be revisited and finalized at the end of the step 1 activity, in which the scope of the AeroMACS specification will be defined in detail.

BACKGROUND

During WRC07 the extended MLS band between 5091 and 5150 MHz was opened for ATC/AOC communication by including a co-primary AM(R)S allocation. Because of its short wavelength and the resulting propagation characteristics this frequency band is primarily suitable for short ranges in particular the airport surface.

During the period from 2005 up to 2007 EUROCONTROL and FAA co-operated

under Action Plan 17 in the development of a future communication infrastructure (FCI) that would be required to support the emerging future concepts as identified today in SESAR and NextGen.

As a result of the FCI study, Eurocontrol and FAA decided to co-operate in the standardization of AeroMACS system – based on IEEE 802.16.

For efficient operations Airlines and Airport operators rely more and more on high data rate IP based applications. Aircraft gate turnaround times can be optimized by providing high data rate radio links - such as AeroMACS - allowing the timely availability of all data required in order to speed-up aircraft arrival and departure procedures. Most of the bandwidth hungry AOC applications are being transferred between AOC centers and aircraft at the gate (software loading, EFB, etc.). Future ATC operations may rely also on new ATC commands while existing ATC messages could be offloaded from existing VDL M2 data links while transmitting on the airport surface.

PATENTS RELATED ISSUES

Just as any other modern commercial mobile communication system available on the market (based on commercial standards such as CDMA 2000, GSM, etc.), WiMAX is likely to be subject to patents. All patents issued for WiMAX (and therefore potentially applicable to AeroMACS) are centralized within the WiMAX Forum (<http://www.wimaxforum.org/resources/ipr>). The WiMAX Forum policy in accepting patents is compatible with the ITU and ICAO policy and allows patents as long as they are made available on a fair and non-discriminatory base.

In general any specific patents and owner of patents need to be identified, and commitment for licensing from the patents owners shall be addressed, as defined by the ARINC patent policy.

As the general idea is to implement AeroMACS based on an existing COTS product, the individual user will not see any patent issues as it will be part of the overall cost. It is believed that patents costs are in the order of 5% of the COTS unit cost (actual cost will depend on previous quantitative roll out of available COTS product and are thus only known to the COTS manufacturer).

TASKING

As mentioned previously, it is proposed to carry out the work in two steps and to start the work in the SAI group for step 1 and then decide the best way to proceed to the step 2 activities which will involve the drafting of the specification. AeroMACS operates in protected spectrum and needs to support not only regularity of flight (AOC) services but also safety of life applications (ATM). As a result AeroMACS may have specific certification and accreditation requirements, for example more stringent than Gatelink.

This standard should target both forward fit installations as well as retrofit installations - if deemed commercially interest.

Potential areas of standardization include:

- FFF box dimensioning for both commercial and business aircraft (if possible)
 - For new developments

- o For forward/retro fits
 - Interface Control Document with related aircraft systems
 - Avionics architecture
 - Handling of security related aspects (such as certificates and / or equipment authorization)

Additional information for the expected standardization areas is provided in section 3.1. Furthermore, it is noted again that the areas that the AeroMACS specification will cover, will be defined in detail at the end of the step1 activity, in which the scope of the AeroMACS specification will be defined in detail.

3.2 Planned usage of the envisioned specification

Note: New airplane programs must be confirmed by manufacturer prior to completing this section.

Use the following symbol to check yes or no below.

New aircraft developments planned to use this specification yes no

Airbus: (aircraft & date) no planning yet
Boeing: (aircraft & date) TBD
Other: (manufacturer, aircraft & date)

Modification/retrofit requirement yes no

Specify: (aircraft & date) TBD

Needed for airframe manufacturer or airline project yes no

Specify:

Mandate/regulatory requirement yes no

Program and date: (program & date)

Is the activity defining/changing an infrastructure standard? yes no

Specify (e.g., ARINC 429)

When is the ARINC Standard required?

2018 _____

What is driving this date? Standardization progress in RTCA, EUROCAE and RTCA and need of avionics specifications to consider further deployment and support planning

Are 18 months (min) available for standardization work? yes no

If NO please specify solution: _____

Are Patent(s) involved? yes

If YES please describe, identify patent holder:

The WiMAX forum organization holds the database with all relating WiMAX (AeroMACS) patents (<http://www.wimaxforum.org/resources/ipr>).

3.3 Issues to be worked

- Query as required WiMAX OEMs and System Suppliers
- Define AeroMACS transceiver form fit and functional
- Avionics architecture

- Define and specify detailed Interfaces to airborne peripherals, i.e., control/display functions, central maintenance functions, etc.
- Propose and define Integration with related broadband and future ATC communication systems
- Define segregation principles from unrelated functions
- Ensure interoperability with other applicable ARINC standards
- Aircraft installation guidelines
- AeroMACS Antennas and cabling specifications
- Other items (TBD)

List to be revisited at end of step1 activity

4.0 Benefits

4.1 Basic benefits

Operational enhancements yes no

For equipment standards:

a. Is this a hardware characteristic? yes no

b. Is this a software characteristic? yes no

c. Interchangeable interface definition? yes no

d. Interchangeable function definition? yes no

If not fully interchangeable, please explain: _____

Is this a software interface and protocol standard? yes no

Specify: _____

Product offered by more than one supplier yes no

Identify: Selex ES, Harris, Honeywell, Hitachi

4.2 Specific project benefits (Describe overall project benefits.)

This section describes the capabilities that are expected to be provided to the aircraft and ground by the installation and operation of AeroMACS.

Due to the use of an all IP radio, the radio can be easily integrated in existing AOC networks or future networks such as PENS (Pan European Network Services) in Europe.

Much higher radio data throughputs will be made available at airport surface compared to existing avionics systems used today such as ACARS or ATN/OSI (VDLM2). While Gatelink (WiFi) is also providing high data throughputs the public ISM band is getting saturated in some regions due to the high interference levels encountered. AeroMACS should not encounter this problem as it will operate in dedicated spectrum reserved for aviation. AeroMACS additionally offers a more remote connectivity to aircraft moving on the taxiways or parked on the apron far from a gate.

AeroMACS will be the first data link that will require IP access into the cockpit. Therefore the AeroMACS work will also facilitate the integration of future IP based ATC radios such as LDACS and the SBB or future SATCOM.

4.2.1 Benefits for Airlines

Airlines will be able to rely on a high-speed data rate connection located in protected (interference free) spectrum and will be able to optimize the airport surface communication between their aircraft and AOC center. The timely availability of needed information on aircraft status will allow faster turnaround times at the gate.

AeroMACS can also be considered as one of the future radio components bringing SWIM to the aircraft (Aircraft Access to SWIM - AAtS).

Because AeroMACS is an all IP radio, integration with existing local AOC IP ground network infrastructure should be simplified.

Several ATC data messages have been identified in the COCR to be carried over AeroMACS (DLL, D-ATIS, DCL, D-OTIS, D-SIG, D-SIGMET, D-TAXI, FLIPCY, FLIPINT, COTRAC (phase 2 ramp) etc.). Some messages are already sent over VDLM2 and will be transferred over AeroMACS to create more capacity on existing European congested VDLM2 channels. Other messages are new and are part of the effort to reduce gate turnaround time or are linked to new 4D trajectory based ATM operations.

Some other (not COCR based) ATC messages are being identified by FAA and are intended to run over AeroMACS as well.

4.2.2 Benefits for Airframe Manufacturers

Airframe Manufacturers could provide diverse communication link options such as AeroMACS – Gatelink to their customers. As multiple avionics equipment suppliers are interested in delivering AeroMACS the airframe manufacturers may offer different supplier choices to their customers.

4.2.3 Benefits for Avionics Equipment Suppliers

Equipment suppliers could benefit from this standard because the common interface description will allow them to provide their radio offering in several configurations.

5.0 Documents to be Produced and Date of Expected Result

ARINC Project Paper 7xx: AeroMACS Avionics Specification

5.1 Meetings and Expected Document Completion

The following table identifies the number of meetings and proposed meeting days needed to produce the documents described above.

Product/Activity	Mtgs	Mtg-Days (Total)	Expected Start Date	Expected Completion Date
Step 1 - AeroMACS Avionics Architecture	4	8 days (4x2)	June 2014	June 2015
Step 2 - ARINC Project Paper 7xx: AeroMACS Avionics Specification	4	8 days (4x2)	June 2015	June 2016

It is expected that 3 or 4 meeting in the context of planed SAI Subcommittee meetings will be required for Step 1 and the rest of the meetings to complete the work in Step 2. This APIM will be updated for step 2.

The in-person meetings will be augmented by web conferences held as necessary.

6.0 Comments

None

6.1 Expiration Date for this APIM

April 2017

Submit completed form to the AEEC Executive Secretary.

-END OF DOCUMENT-

founding members



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