AeroMACS
Aeronautical Mobile Airport Communication System
Standardized Solution for the Airport Surface

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AeroMACS Evolution

1. Study
2. Spectrum
3. Harmonization
4. Security
5. Deployments
6. Regularity

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Over a Decade Setting Parameters

Future Communications Study
Make recommendation

Spectrum Allocation
Define spectrum

Requirements
Ensure compliance and interoperability

Compliance
Test, implement and manage SARPs compliant system

Characteristics
Certify, build and approve AeroMACS systems

SARPs
Ensure compliance and interoperability

Compliance
Test, implement and manage SARPs compliant system

Characteristics
Certify, build and approve AeroMACS systems

Technical Manual/Technical Profile

MASPS/MOPS/Specifications/Aircraft Installation
AeroMACS Systems have the capacity, speed, performance, security and reliability needed to support a multitude of fixed and mobile applications on the airport surface.

### Systems Assessment

<table>
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<th></th>
<th>ACARS</th>
<th>Wi-Fi Gatelink</th>
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<th>AeroMACS</th>
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* With the exception of roaming traffic

### Real-World Network Speeds (Kbps)

- **VDM2**: 31.5 Kbps
- **Swift BB**: 432 Kbps
- **3G**: 100 Kbps
- **4G LTE**: 1000 Kbps
- **WiFi**: 2000 Kbps
- **AeroMACS**: 7000 Kbps

Approved for Safety Services
AeroMACS Spectrum Allocation

AeroMACS SHALL support 5 MHz channels in the 5091 MHz – 5150 MHz band

- 5091 MHz – 5150 MHz: AeroMACS Spectrum has been Internationally Allocated by ITU at WRC-07 in 2007 (Co-primary AM(R)S allocation)

- 5000 MHz – 5030 MHz: possible national allocations

(Possibly) National Allocations

Current International Allocation by ITU
Global Coordination & Harmonization

ICAO Aeronautical Communications Panel, Recommendation Future Communications Study

ITU WRC-07 approved spectrum allocation for 5091-5150 MHz for AeroMACS

AeroMACS profile based on IEEE 802.16e - 2009 standard

- **FAA and EUROCONTROL**
  - TSO-C207a – AeroMACS Airborne Mobile Station (AMS) Equipment

- **RTCA SC-223** and **EUROCAE WG-82**
  - DO-345/EUROCAE ED-222: AeroMACS Profile
  - DO-346/EUROCAE ED-223: AeroMACS MOPS
  - EUROCAE ED-227: AeroMACS MASPS

- **ICAO** Aeronautic Communications Panel Surface Datalink Working Group (WGS)
  - ICAO Doc 10444 – AeroMACS Technical Manual
  - ICAO ANNEX-10, Volume III, Chapter 7: AeroMACS SARPs

- **ARINC AEEC** AeroMACS Working Group
  - ARINC 766: Aeronautical Mobile Airport Communication System (AeroMACS) Transceiver and Aircraft Installation Standards
<table>
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<tr>
<th>Mobile Apps</th>
<th>Fixed Apps</th>
<th>Air Traffic</th>
<th>Air Carriers</th>
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<td>✓ Navigation Aids</td>
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<td>✓ Data uploads and downloads</td>
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<td>✓ Catering</td>
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<td>✓ Terminal Sensor</td>
<td>✓ EFB</td>
<td>✓ Lighting</td>
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<td>✓ Visual Aids</td>
<td>✓ Flight Info.</td>
<td>✓ NOTAM-D</td>
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<td>✓ Weather</td>
<td>✓ Fueling</td>
<td>✓ Surface Mgmt.</td>
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<td>✓ Wild Life Mgmt.</td>
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</table>

Over 330 Applications Identified
AeroMACS Worldwide Roadmap

2009
- U.S. CLE

2010
- France TLS

2012
- U.S. SFO

2014
- China CTU
- Brazil MLB
- Germany OBF
- Japan SDJ
- Syria SYR

2016
- U.S. KWL
- Brazil MXP

2017
- China CIN
- China CKG
- Japan HND
- China INC
- China KWE
- China PEK
- China SHE
- Japan TSN
- Japan XNY
- China XNN

2018
- Brazil GIG
- China HAK
- Portugal LIS
- China MCI
- China MSY

2019+
- U.S. ACY
- China CAN
- Argentina EZE
- U.S. HNL
- U.S. PDX
- U.S. ADW
- China CGO
- China FOC
- U.S. HRL
- U.S. PHL
- U.S. MLB
- Argentina GZC
- China KML
- China PIT
- China SYR
- China DAB
- China GZH
- China NKG
- China PRG
- China BOS
- China DLC
- China HHA
- China NNG
- China PVC

AeroMACS Worldwide Roadmap

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CLE - Cleveland Airport - NASA

Aircraft Communication
Weather
Moving Maps
Surveillance
Mobility
Voice Over IP

Cleveland-Hopkins International Airport
FAA (ASSC)

Airport Surface Surveillance Capability

• On contract to deploy ASSC at 9 airports, and 3 support systems with options for up to 58 more to leverage airport surface detection equipment.

• Completed Site Acceptance Test (SAT) at SFO, the key site. Production activities well underway for the next airports and support systems.

SFO - San Francisco Airport
AeroMACS Construction Plan

Chinese AeroMACS frequency is centrally controlled and the licenses are released by State Radio Regulatory Commission (SRRC) and CAAC.

ADCC has been formally authorized AeroMACS frequencies in 2017 to setup 110 airports AeroMACS network and provide services.

ADCC has already setup AeroMACS in 11 Airports in China and plans to install AeroMACS in the top 30 traffic rank before the end of 2019.
CTU - Chengdu Airport D-Taxi and A-SMGCS over AeroMACS
PEK - Beijing Airport D-Taxi

Air China, China Eastern Airline, Hainan Airline and Shandong Airline participated in the D-TAXI system cockpit trial in the period of departure and landing taxi stage via AeroMACS providing real-time guidance by the ATC control tower.
Honeywell Portable AeroMACS D-Taxi App

- D-Taxi Application is fully compliant with ATN-B2 message set RTCA SC-214/DO-350A EUROCAE ED-228A
- Supports IPS communications over AeroMACS
- Integrates multiple applications on the EFB/iPad: d-Taxi, A-SMGCS with moving map display, baggage handling and airline operations optimization, vehicle management, VoIP, Video
- Conducted safety assessment and mitigation for taxi guidance on COTS iPad
- Prototype AeroMACS portable unit can be used for vehicles, Ramp management staff and for aircraft trials
- **ARINC 766 compliant AeroMACS avionics radio under development**

Prototype Integrated AeroMACS with iPad EFB – about 1.5” thick
Civil Aviation Administration of China (CAAC) and Aviation Data Communication Corporation (ADCC) reported that modified procedures using AeroMACS reduced the clearance delivery time by twenty minutes per flight. It substantially improved operating efficiency of the Tower Control as well as overall integrity of the clearances.

Source: Aloke Roy, Senior Program Manager at Honeywell
Publication: AeroMACS: It’s like a Real-time GPS, but Better!
Since it’s deployment in 2012

- LVP (Low Visibility Message) panels installed in LIS’s Airport around the airside using WIMAX connectivity
LIS - Lisbon

CCTV perimetric IP Cameras around the airside
Fire department and operational vehicles connectivity
What can we offer as an AeroMACS operator inside Lisbon’s Airport?

- Accelerate project implementations by deploying applications on any point of the airside
- Interconnect to external stakeholders like Ground Handling, ANSP, Airlines to permit collaboration
- Easily implement a network access point on request for a critical situation

All of this in reduced budget, with much less equipment needs and easy to maintain network infrastructure
Europe

TLS - Toulouse

MXP - Malpensa
Japan

SDJ - Sendai  HND - Haneda

Test Results
AeroMACS network is demonstrated to be secured.

SWIM Network

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GIG - Galeao

• For the coverage two classes of services have been created:
GIG - Galeao - Multilateration

- **Fixed service with CPE**
  - 4 CPE fixed at 10 meters
  - 2 CPEs installed at vehicles

- **Customer Requirements**
  - Wireless broadband network connectivity to Remote Sensor units deployed around perimeter of airport to locate airplanes while taxing to take off or after landing.

Enables airplanes location and visibility on the runways while taxing promoting the safety of passengers and regularity of flights.
GIG - Galeao - Hydroplaning

- Mobile service with antenna
  - 1 BTS at 10 meters antenna
  - 1 BTS at 20 meters antenna

- Customer Requirements:
  - Private secured wireless network as a multi service platform for mobile communications.
AeroMACS Aircraft Tests

Existing VHF antenna replaced by AeroMACS Sensor Systems

Validation tests conducted using a Boeing 737-700 aircraft.

Route options, weather information and other data transmitted by NASA to FAA Bombardier Global 5000.

AeroMACS and Telemetry tests at Embraer facility.

Airbus aircraft installation and rational.
AeroMACS Global Contributors
AeroMACS - WiMAX Forum®

- **Industry-led**, not-for-profit organization that certifies and promotes the compatibility and interoperability of broadband wireless products based on IEEE Standard 802.16 across various industries from Telecommunications (WiMAX) to Energy (WiGRID) and **Aviation** (AeroMACS) since **2001**.

- The WiMAX Forum with the collaboration of its member companies, industry leaders, experts, technology providers, **EUROCONTROL**, **FAA** and **ICAO** has been producing important work to increase awareness and advance AeroMACS as the standardized and secure broadband connectivity for the aviation industry.

- The WiMAX Forum has been instrumental in **all stages** of AeroMACS’ growth, from its initial launch, when we facilitated the development of a system profile, to current global expansion efforts. **We're Here to Help!**
AeroMACS is the standardized wireless technology selected to provide safety and regularity of flight on the airport surface globally.

AeroMACS operates in the protected and licensed aviation spectrum band to enable and improve ground communications.
AeroMACS – What Is Next?

According studies and analysis, AeroMACS has been identified as a strong candidate to be used as an aviation standard for the Unmanned Aircraft Vehicles (UAV).

It has been recognized that AeroMACS can be an essential technology paving the way to fully integrate UAV into airspace operations providing a safe and efficient environment.
Gracias! Obrigada! Thank You!

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Back-up Slides
Frequency & Channel Distribution

The channel spacing is 5 MHz without a guard band between adjacent channels.

The frequencies listed are available for AeroMACS operation after registration with, and assignment by, the Channel Manager.

*SOME level of Radio Regulatory coordination will be advised in all countries as potentially competitive users will seek to acquire spectrum.*
AeroMACS Features

- Operates in a regulated spectrum (5GHz) offering protection from interference.
- Globally standardized datalink, offering high capacity and secure communications on the airport surface.
- Supports Air Traffic Control, Airline Operation and Airport communications using single technology.
- Part of wider aviation communication infrastructure approved to support the safety and regularity of flight.
The U.S. Federal Aviation Administration (FAA) has identified over 330 AeroMACS applications under 5 categories:

- **Air Traffic Control/ Air Traffic Management Applications**
- **Aviation Information Systems/ Meteorology Applications**
- **Airline Operations Applications**
- **Safety Applications**
- **Airport Infrastructure Applications**
AeroMACS Network Infrastructure

Regulators
Ensure that air traffic, security and safety management follow regulation

Air carriers
Support air traffic, security and safety applications on aircraft, and carrier applications

Airports
Support airport operations and any applications mandated by regulators

Suppliers
Provide equipment, services, network applications and management tools

Synergy to share the network infrastructure and its benefits
AeroMACS Basic Scenarios

Transmission from control tower to aircrafts

Transmission from aircrafts to control tower

Apron

Runway

Taxi

Parking
AeroMACS Security

AeroMACS Public Key Infrastructure (PKI) provides the digital certificates to aircraft, ground device, and servers for strong device to device authentication. This mechanism provides the foundation for application authorization, access control, and data confidentiality.

AeroMACS PKI:
- Minimizes cyber threats
- Provides efficient, reliable, and secure broadband connectivity across the entire airport footprint
- Securely collects data from fixed and mobile terminals
- Securely maintains communications with staff and aircraft