

AeroMACS Enabling Safe and Secure Connectivity Worldwide



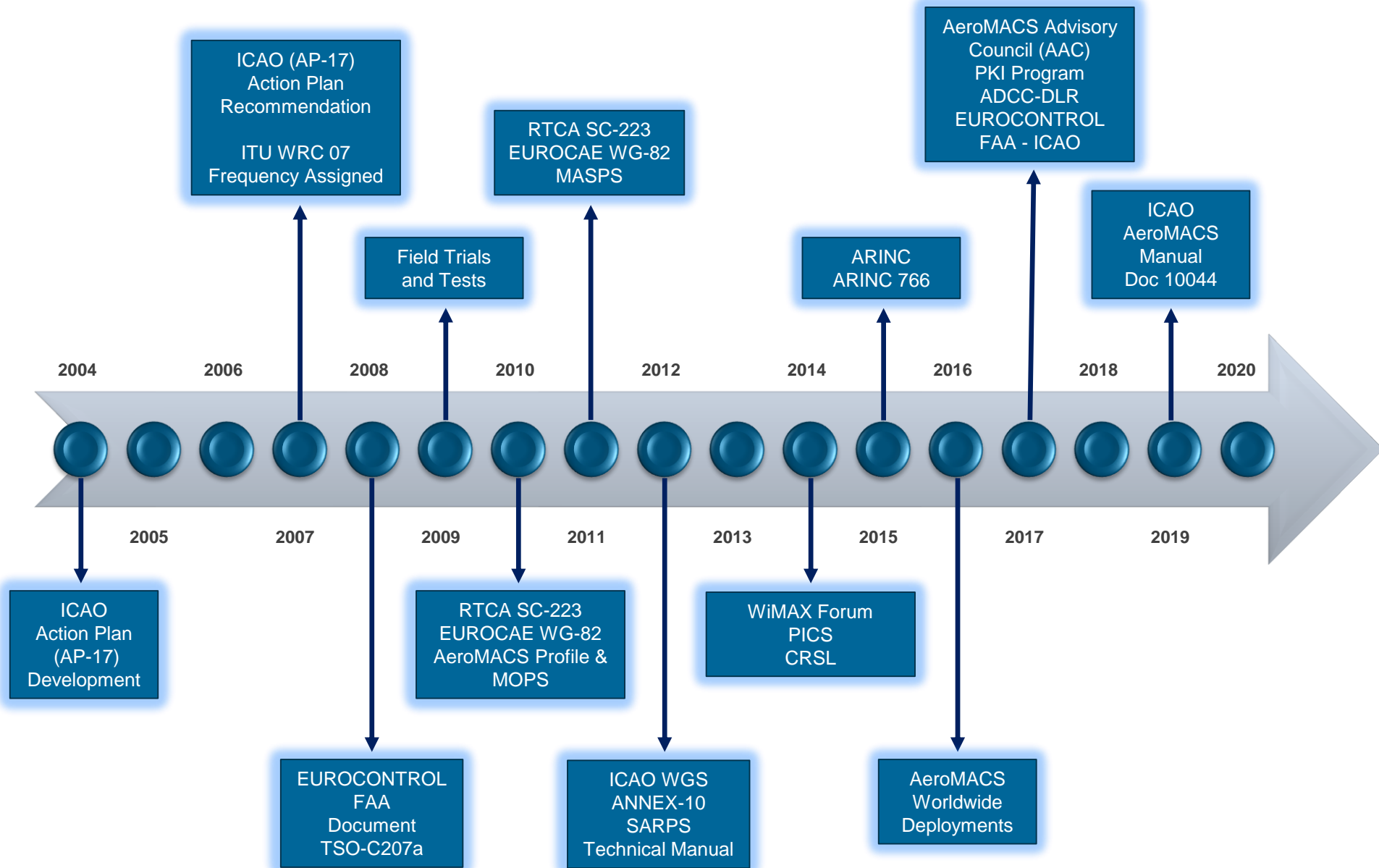
Declan Byrne, AeroMACS - WiMAX Forum, President
November 2019

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 Standards Development



Global Harmonized Profiles & Standards



- **ICAO** Future Communications Study Recommendation. AeroMACS is part of FAA and EUROCONTROL's joint strategy and roadmap
- **ITU** WRC-07 approved internationally spectrum allocation from 5091 MHz to 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: AeroMACS Transceiver and Aircraft Installation Standards



AeroMACS is the standardized technology selected to improve ground communications infrastructure!



AeroMACS PICS and CRSL

Standardization Groups



AeroMACS Certification Specifications

- WiMAX Forum® AeroMACS - Protocol Implementation Conformance Statement (PICS)
- WiMAX Forum® AeroMACS - Certification Requirements Status List (CRSL)



AeroMACS Standardization Process

ITU WRC-07 AM(R)S Allocation



AeroMACS Standards

EUROCONTROL
FAA



AMS
Equipment

EUROCAE
RTCA



AeroMACS
Profile

AeroMACS
MOPS

AeroMACS
MASPS

ICAO



AeroMACS
SARPs

Technical
Manual

AEEC



ARINC 766

WiMAX Forum



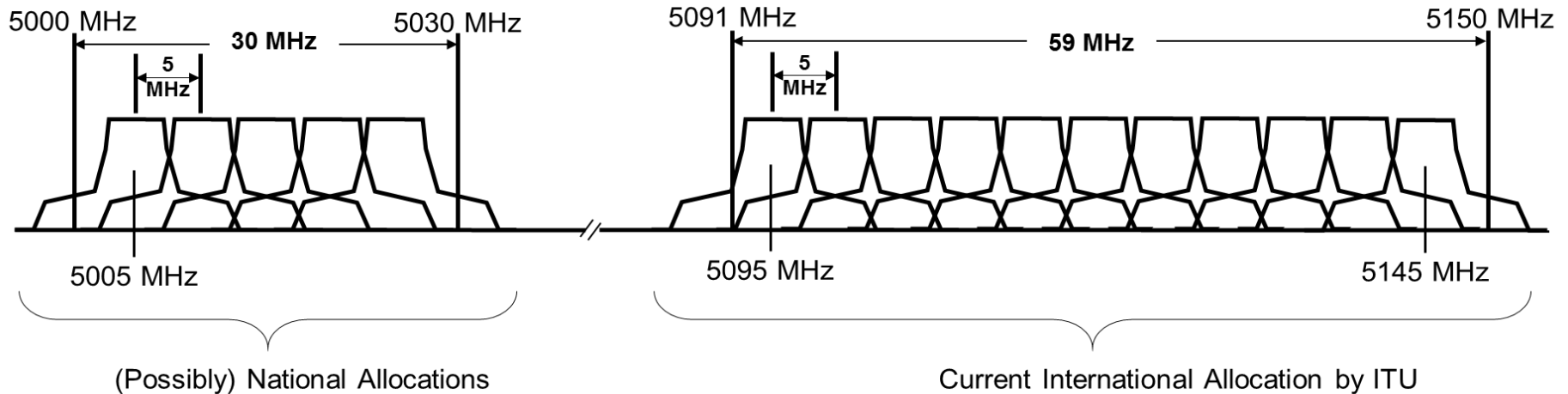
PICS

CRSL

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

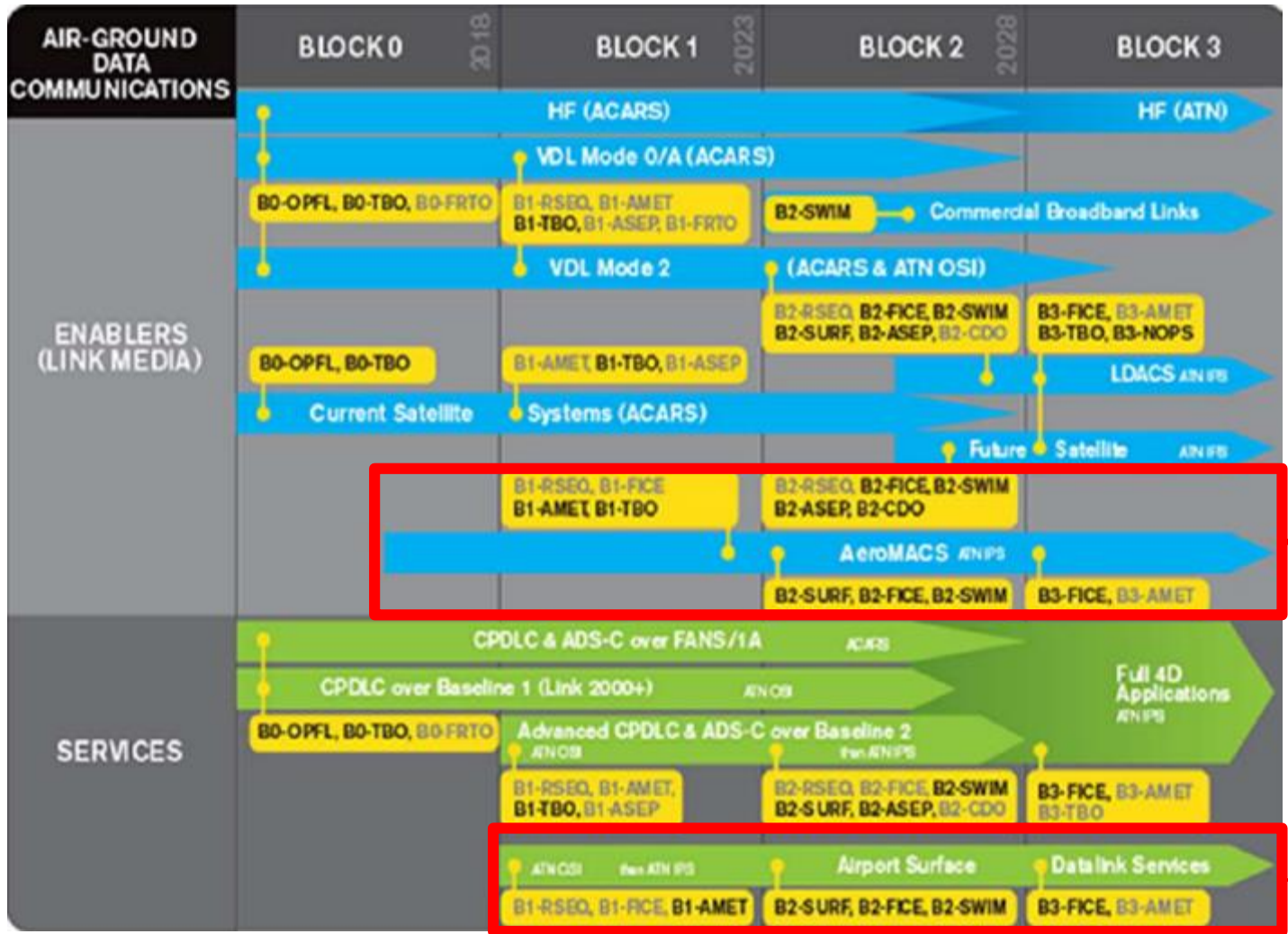


ICAO Global Air Navigation Plan

AeroMACS ground-based high capacity airport surface data link enabler and it is part of GANP and Aviation System Block Upgrades (ASBU).

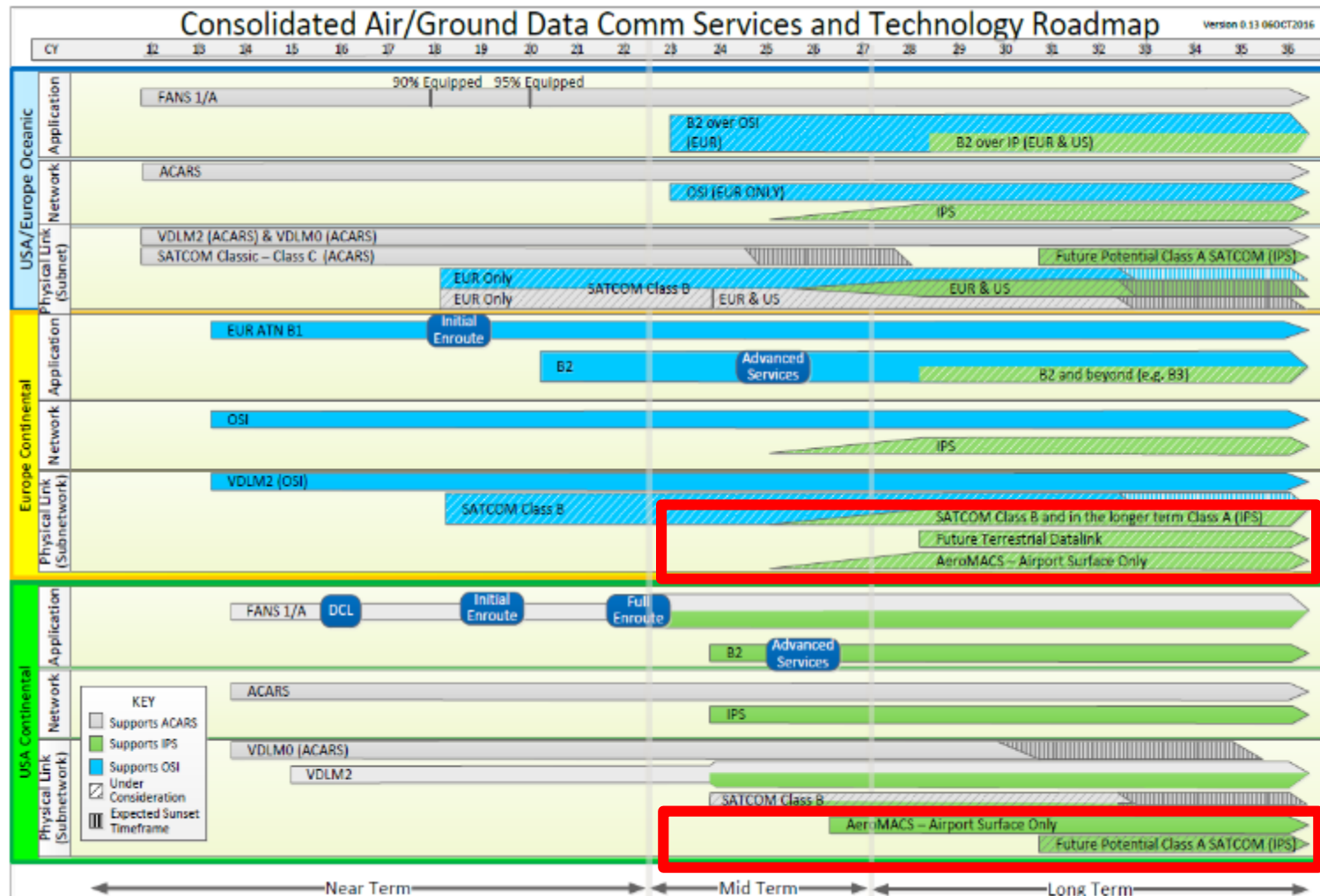


2016-2030
Global Air Navigation Plan



Eurocontrol - FAA Harmonization

AeroMACS is the first of the new standardized communications enablers of the future communications infrastructure required to support emerging operating concepts from NextGen and SESAR.



Motivation

Airports are becoming slot-limited and the only way to expand capacity, improve efficiency, increase security and avoid global bottleneck is technology



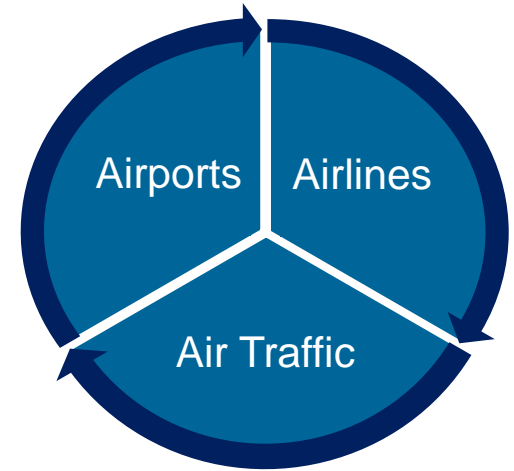
AeroMACS systems have the capacity, speed, performance, security and reliability needed to support a multitude of fixed and mobile applications

AeroMACS is the standardized wireless technology selected to provide safety and regularity of flight on the airport surface globally

Overview

AeroMACS Benefits

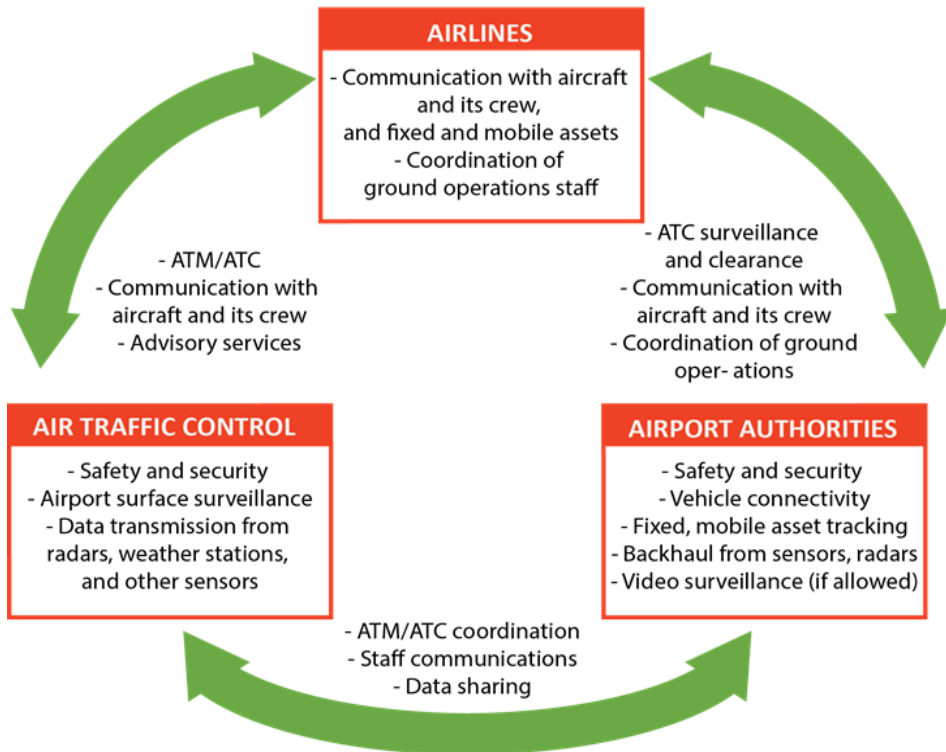
- **Improved Traffic Management on Airport Surface**
 - Improved Taxi-Out Times to lower flight delays
 - Location-based data for all authorized GHE and A/C in good or poor visibility conditions
 - Enhanced and more timely weather information
- **Enhanced Airport and Airline Safety**
 - Improved situational analysis for controllers and pilots
 - Greater reliance on data, graphic & video on cockpit displays in lieu of more error-prone
 - Detect, deal with, & minimize danger of runway incursions
- **Higher Airport Security Measurements**
 - Video surveillance for enhanced protection against unauthorized airport entry



Beneficiaries include: Aviation Authority, Airport Operator, Airline Carrier and Aircraft Owners, Pilots and Passengers

Infrastructure

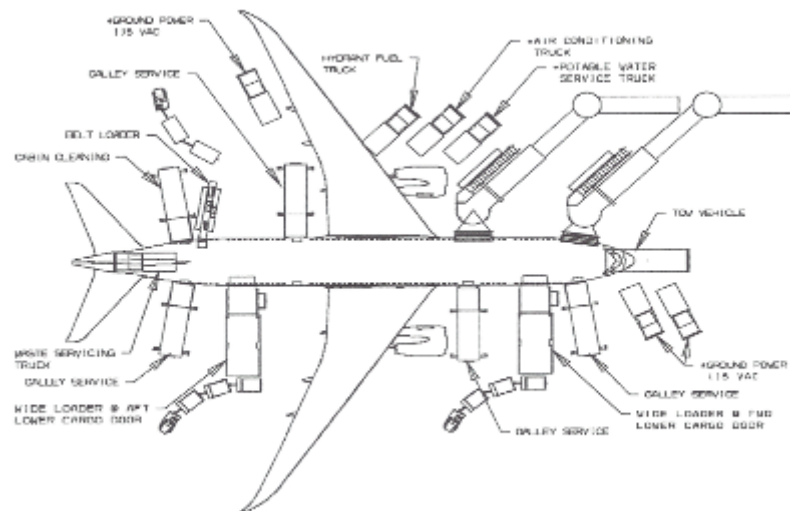
Stakeholders



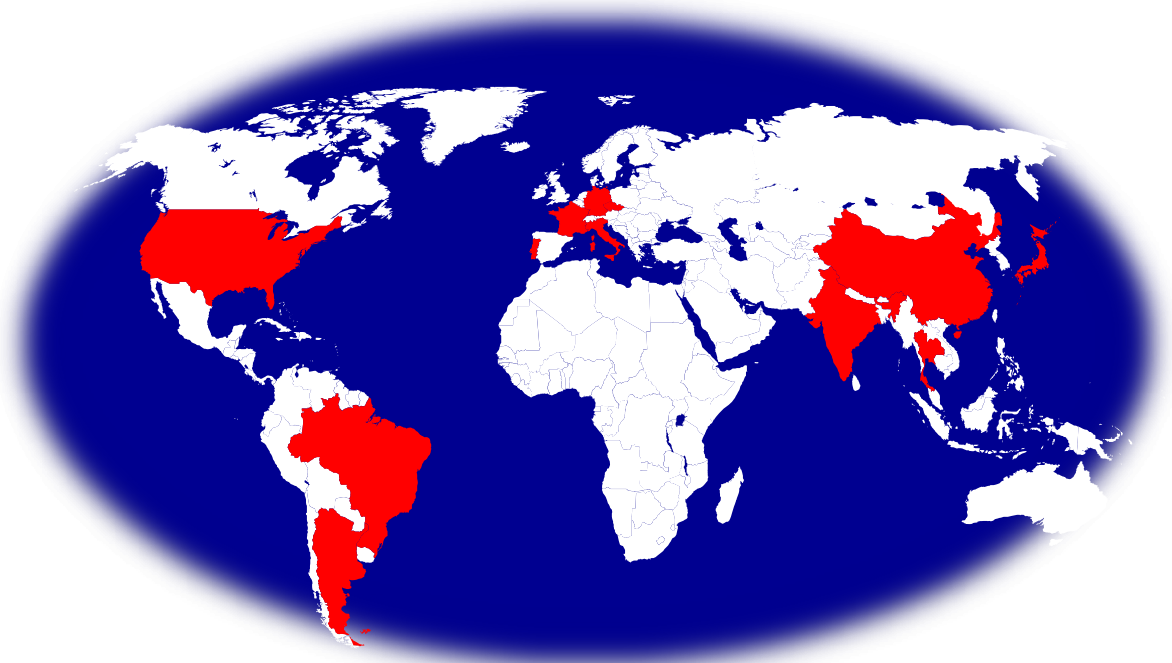
Fixed and Mobile Applications



Ground Handling Equipment (GHE)



AeroMACS Worldwide Roadmap



2009
 CLE

2010
 TLS

2012
 LIS
 SFO

2014
 CTU
 MLB
 OBF
 SDJ
 SYR

2016
 CVG
 CKG
 MXP
 PEK
 TSN

2017
 HAK
 HND
 INC
 KWE
 LHW
 MCI
 SHE
 URC
 XIY
 XNN

2018
 ACY
 DOY
 DYG
 KHN
 MSY
 NKG
 PIT
 PVG
 SHA
 TAO
 TNA
 XMN

2019
 ANC
 BWI
 DTW
 GIG
 PDX
 WNZ

2020+
 ADW
 BKK
 BLR
 BOS
 CAN
 DAB
 EZE
 FOC
 HNL
 KMG
 PHL

South America – Brazil



GIG - RioGaleao

Requirements

- **Multilateration** - Wireless broadband network connectivity to Remote Sensor units deployed around perimeter of airport to locate airplanes while taxiing to take off or after landing
- **Hydroplaning** - Private secured wireless network to be used as a multi service platform for mobile communications and hydroplaning information

AeroMACS GIG Multilateration

- Fixed Service - Multilateration



Multilateração – Unidade Remota

Fixed service with antenna

2 BTS at 50 meters antenna

3 CPE at 20 meters

Antenna Terminal 1

- Azimuth: 200°
- Beam tilt: -5°

Antenna Terminal 2

- Azimuth: 150°
- Beam tilt: -5°

SETUP Fixed Service



AeroMACS GIG Hydroplaning

- Mobile Service - Hydroplaning



Pista de Decolagem

Mobile service with antenna

- 2 BTS at 50 meters antenna
- 1 CPE installed at vehicle
- 1 camera installed at vehicle



SETUP Mobile Service



AeroMACS - RIOgaleao - Siemens

Video Transmission with vehicle in movement

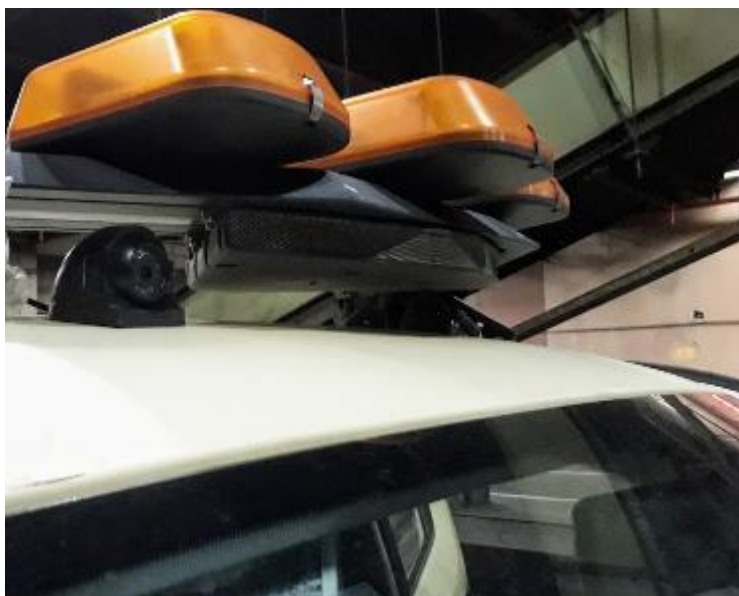
Access to areas with difficult access and connection with real time movement track



<https://www.youtube.com/watch?v=dIkiPcoau7M>

AeroMACS at RIOgaleao

- For the coverage two classes of services have been created initially
- AeroMACS in progress: IoT and Ground Vehicles Tracking
- Other possible applications proposed
- National regulation necessary
 - Anatel currently under public consultation review



North America – United States



CLE - Cleveland Airport - NASA



SFO - San Francisco Airport



FAA Airport Surface Surveillance Capability (ASSC)

- AeroMACS has been deployed at 12 airports in US
- ASSC contract at 9 airports, and 3 support systems
- With options for up to 58 more to leverage airport surface detection equipment

Asia – China



CTU - Chengdu Airport



PEK - Beijing Airport



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

AeroMACS Construction in China

- 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. **22** Airports have already been set up
- Civil Aviation Administration of China (CAAC) and Aviation Data Communication Corporation (ADCC) reported that modified procedures using AeroMACS reduced the clearance delivery time by **20** minutes per flight
- AeroMACS substantially improved operating efficiency of the Tower Control as well as overall integrity of the clearances



中国民用航空局空中交通管理局

民航总局函〔2017〕69号

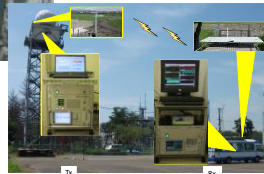
关于转发《民航局空管办关于机场航空移动通信系统使用频率的批复》的通知

民航数据通信有限责任公司：

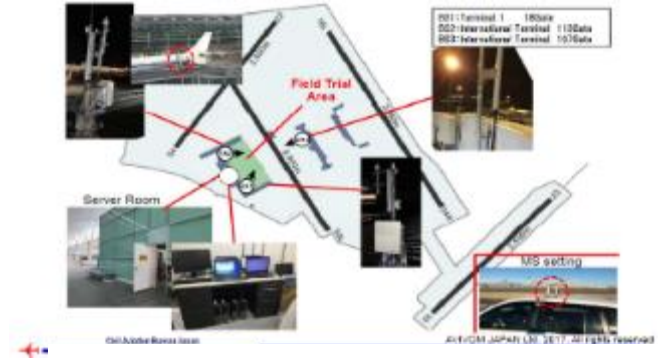
经《民航局空管办关于机场航空移动通信系统使用频率的批复》（民航空管〔2016〕15号）转发给你们，请贵公司负责落实以上批复的要求，备案，按照民航局空管办批复的要求及民航局空管办批复的工作。



Asia – Japan



SDJ - Sendai



HND - Haneda

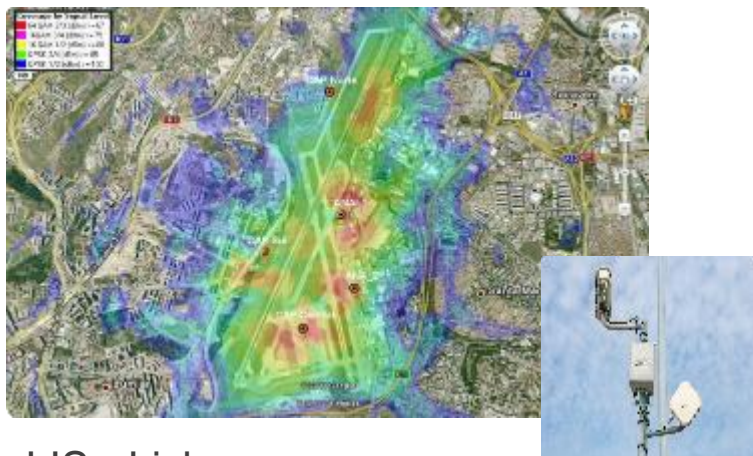
Summary : Airport Innovation through AeroMACS



- AeroMACS network demonstrated to be secured through device certification and authentication
- ATC traffic is always prioritized to be delivered over any other traffic
- There is no area of “Out of Service” on airport vehicle routes

Europe – Portugal

- CCTV perimetric IP Cameras around the airside
- Fire Department's Mobile Command Post connectivity, CCTV
- LVP (Low Visibility Message) panels installed in LIS's Airport around the airside
- Operational vehicles connectivity



LIS - Lisbon



Europe – Portugal



Lisbon Airport AeroMACS Usefulness



What can **we offer** as an **AeroMACS** operator inside Lisbon's Airport?

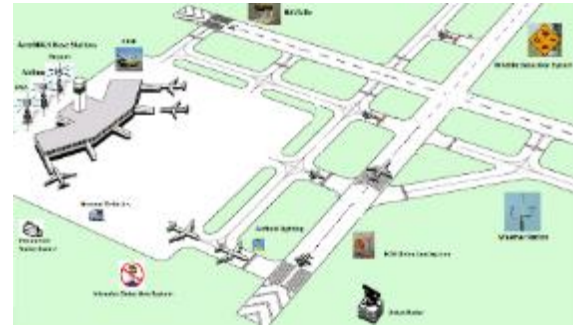
- Accelerate project implementations by deploying applications on any point of the airside
- Interconnect to external stakeholders like Ground Handling, ANSP, Airlines to permit collaboration
- Easily implement a network access point on request for a critical situation

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

March 2019

AeroMACS PKI

- 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.
- PKI provides value 3 ways:
 - Encryption: prevents eavesdropping
 - Mutual Authentication: prevents unwanted access
 - Integrity: prevents tampering
- AeroMACS PKI:
 - Requires digital certificate based on strong authentication across the AeroMACS system
 - Minimizes cyber threats
 - Securely collects data from fixed and mobile terminals
 - Securely maintains communications with staff and aircraft



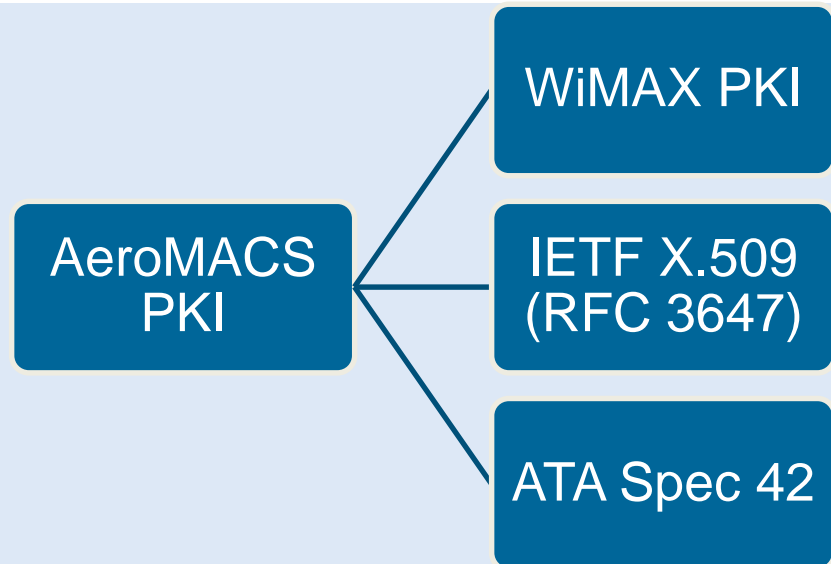
AeroMACS PKI provides efficient, reliable and secure broadband connectivity for the entire airport footprint, aircrafts, networks, operations and services

AeroMACS PKI Development

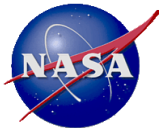


The AeroMACS Certificate Policy has been accepted in ICAO WG-S and included as an appendix in the Guidance Material of the Technical Manual. Certificate Profile Requirements included in the Technical Specifications section of the Manual.

Using Internet and Aviation security standards and in collaboration with the industry, WiMAX Forum started AeroMACS PKI solution development.



AeroMACS Global Contributors



AeroMACS

At Work



A number of activities are scheduled to take place this year, if your company is not participating, please contact us at info@wimaxforum.org to learn how you can get involved.

It is a crucial time for your organization to influence and leverage AeroMACS activities and contribute to the market development and growth.

For more information on AeroMACS, please visit:
<http://wimaxforum.org/Page/AeroMACS>.

Gracias! Obrigado! Thank You!

