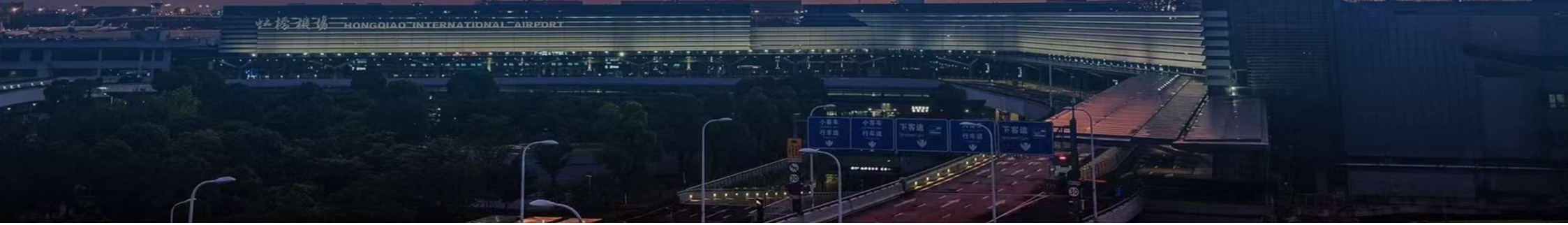
中国民用航空局 空中交通管理局
Air Traffic Management Bureau.CAAC

AeroMACS 2.0
AeroMACS based on 5G communication technology

Concept, Application, Challenges and Prospects of Next Generation Airport Mobile Communication System for Airports



CONTENTS

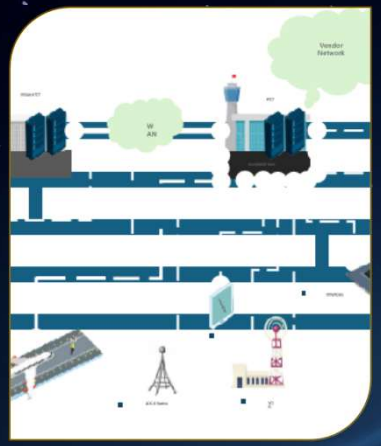
1

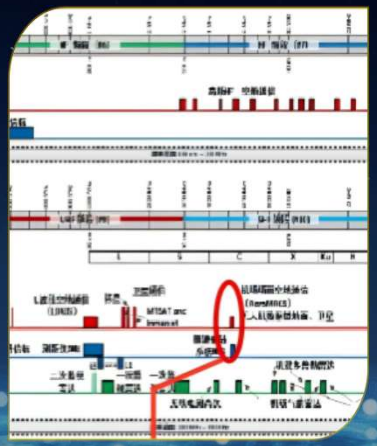
The Concept of AeroMACS

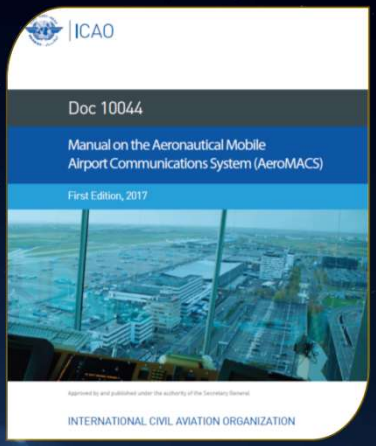
AeroMACS is a wireless broadband data link technology dedicated to civil aviation airport safety communications and is the only ICAO-recognized technology suitable for airport safety communications.

Origin and Development of AeroMACS

ICAO-recognized Safety Communication Technology for Airports







2003

At the 11th ICAO ANC (2003), EUROCONTROL/FAA AP17 recommends C-band AeroMACS deployment

2012

AeroMACS provides secure, standardized airport broadband for aircraft, vehicles, and personnel

2015

ITU Radio Regulations 5.444B: Use of the 5091-5150 MHz band by the Aeronautical Mobile Service

2016

AeroMACS incorporated into ICAO Annex 10, Volume III

2017

Publication of ICAO Doc 10044: Manual on the Aeronautical Mobile Airport Communications System (AeroMACS)

CAAC Promotes Implementation of Aviation AeroMACS 2.0 Technology and Applications

AeroMACS 2.0 integrates the AeroMACS spectrum with China's 5G technology advantages. By customizing 5G technology for aviation, it serves as the communication infrastructure for Smart Civil Aviation.

2021.4


中国民用航空局
Civil Aviation Administration of China

中国民用航空局关于印发中国民航新一代航空宽带通信技术路线图的通知

CAAC issued the "Roadmap for the Development of New-Generation Aeronautical Broadband Communication Technology".

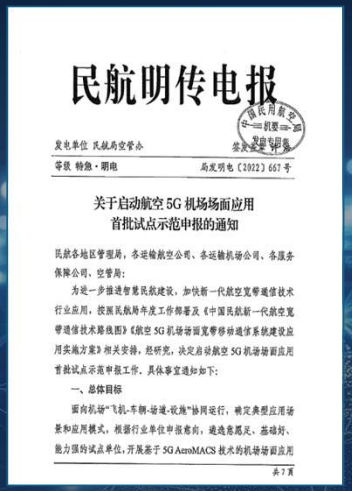
2022.1


中国民用航空局
Civil Aviation Administration of China

发布 | 中国民用航空局关于印发航空5G机场场面宽带移动通信系统建设应用实施方案的通知

CAAC issued the "Implementation Scheme for the Construction and Application of Aviation 5G based Airport Surface Broadband Mobile Communication Systems".

2022.3


民航明传电报

关于启动航空 5G 机场场面应用首批试点示范申报的通知

CAAC launched the application process for the initial pilot demonstration projects.

2022.6


民航明传电报

关于下发航空 5G 机场场面应用试点示范项目评审会议纪要的通知

Hongqiao, Shuangliu, Guangzhou, and Ezhou Huahu were designated as the initial pilot demonstration airports.

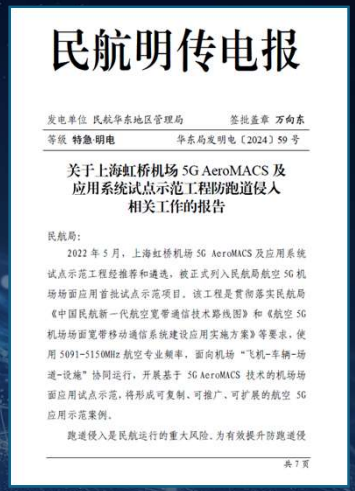
2022.11


民航明传电报

关于下发《航空 5G 机场场面宽带移动通信系统地面站技术要求（试行）》的通知

CAAC issued the "Technical Requirements for Ground Stations of Aviation 5G based Airport Surface Broadband Mobile Communication Systems".

2024.1


民航明传电报

关于上海虹桥机场 5G AeroMACS 及应用系统试点示范工程防跑道侵入相关工作的报告

Pilot applications of AeroMACS 2.0 and its associated systems have achieved significant results.

Airborne Broadband Communication System

Aviation AeroMACS 2.0

China Civil Aviation's aeronautical customization of AeroMACS using 5th Generation communication technology

Compliant with ICAO international standards (Private Network)

- Incorporated into ICAO Annex 10, Volume III
- Planned in the ASBU roadmap for airport surface communications

01

Exclusive Operating Frequency (Specific Frequency)

- 5091 MHz – 5150 MHz @ ITU, applied to all airport surface communication scenarios

02

Dedicated Civil Aviation Network (Private)

- A communication network dedicated to aeronautical operations within the airport perimeter
- Nationwide airport systems integrated into a single network

03

High Security

- Supports network security systems
- The only airport-wide medium capable of transmitting safety-related data

04

5G Technical Advantages

- High bandwidth, low latency, massive connectivity
- Strong real-time performance, meeting various civil aviation business requirements

05

Mobility Support

- Supports high-speed mobility on airport surfaces: ≤300Km/h
- Supports mobile access for aircraft, vehicles, and various types of equipment

06

AeroMACS is a vital infrastructure for civil aviation safety data communications

2

Equipment and Network of AeroMACS 2.0

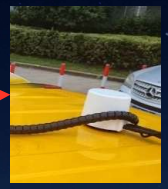
Having established the conceptual and policy framework for AeroMACS 2.0, we now move to the second part of this presentation: The Equipment and the Network.

Equipment Development

Completion of critical network equipment development

Terminal Equipment (Vehicle, Airborne, Fixed)

- Customized frequency band solution for aviation
- Compatibility with avionics equipment
- Support for multiple carrier bandwidth communication



Antenna

- Multiple antenna options for different network coverage scenarios
- High-quality network signal coverage capability

RF Unit

- Transmit power not exceeding 1W and effective network coverage distance of up to 1.7KM
- High signal reception sensitivity

Outdoor Equipment

Data Management Unit

- Customized network security strategy and onboarding process for aviation 5G
- Exclusive network management capability for aviation
- QoS guarantee for different terminal services

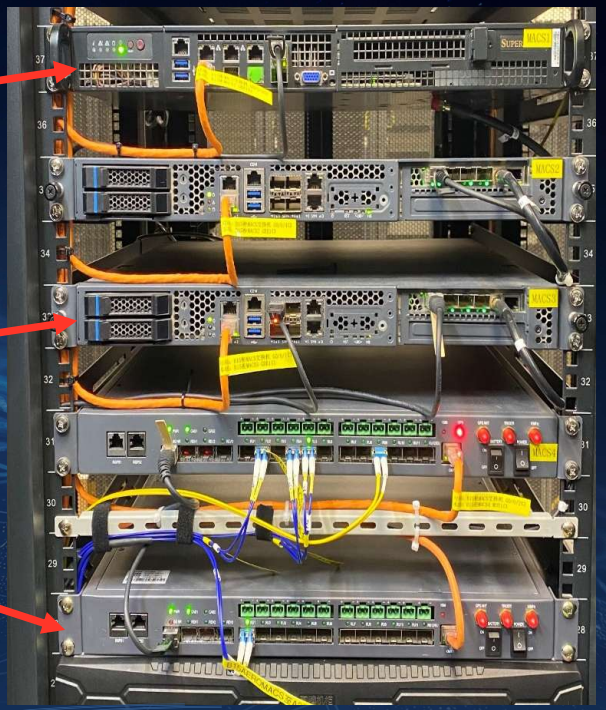
Baseband Processing Unit

- Customized development of aviation-specific frequency bands using 5G technology
- Customized baseband processing for aviation, supporting multiple frame structures to meet aviation-specific business requirements

Signal Aggregation Module

- Efficient management of outdoor ground stations with aviation 5G customized equipment
- Effective protection of communication security and stability for outdoor ground stations

Indoor Equipment



Fiber Optic Connectivity

AeroMACS 2.0 Outdoor Unit

Terminal access equipment

Customized core modules, antennas, and development of multiple types of terminal equipment

Airborne equipment

CPE terminal equipment

On-board equipment for temporary construction vehicles

On-board equipment

Portable on-board equipment

Outdoor equipment

Terminal equipment

- **Airborne equipment**
  - Plan to complete 737 Max STC certification in Q2 2026
- **On-board equipment, on-board equipment for temporary construction vehicles**
  - Productized / Commercialized
- **Outdoor equipment**
  - Productized / Commercialized
- **CPE terminal equipment**
  - Productized / Commercialized
- **Portable on-board equipmen**
  - Productized / Commercialized

Terminal access equipment

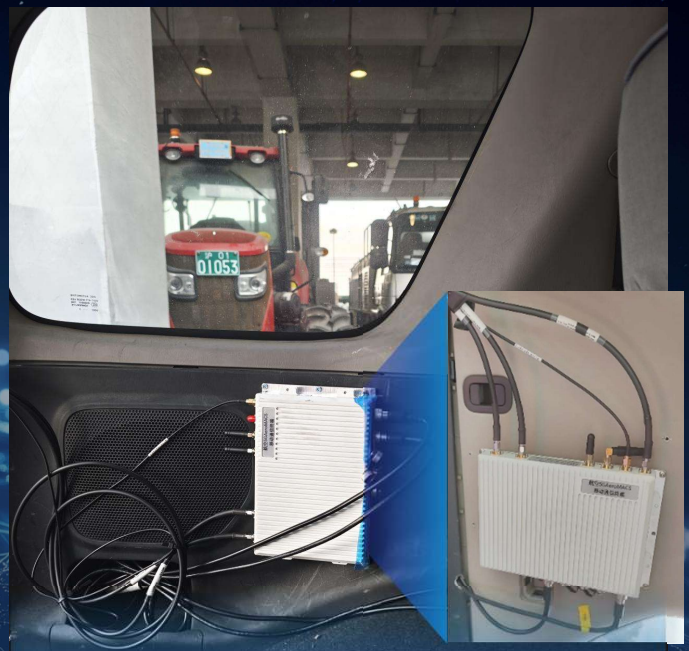
Vehicle-mounted AeroMACS 2.0 terminal device

Wireless access network

Supports 5G Areo MACS

LAN

- Supports Wifi 2.4G
- Supports Wifi 5.8G networks
- Supports LAN connectivity (4 LAN ports)

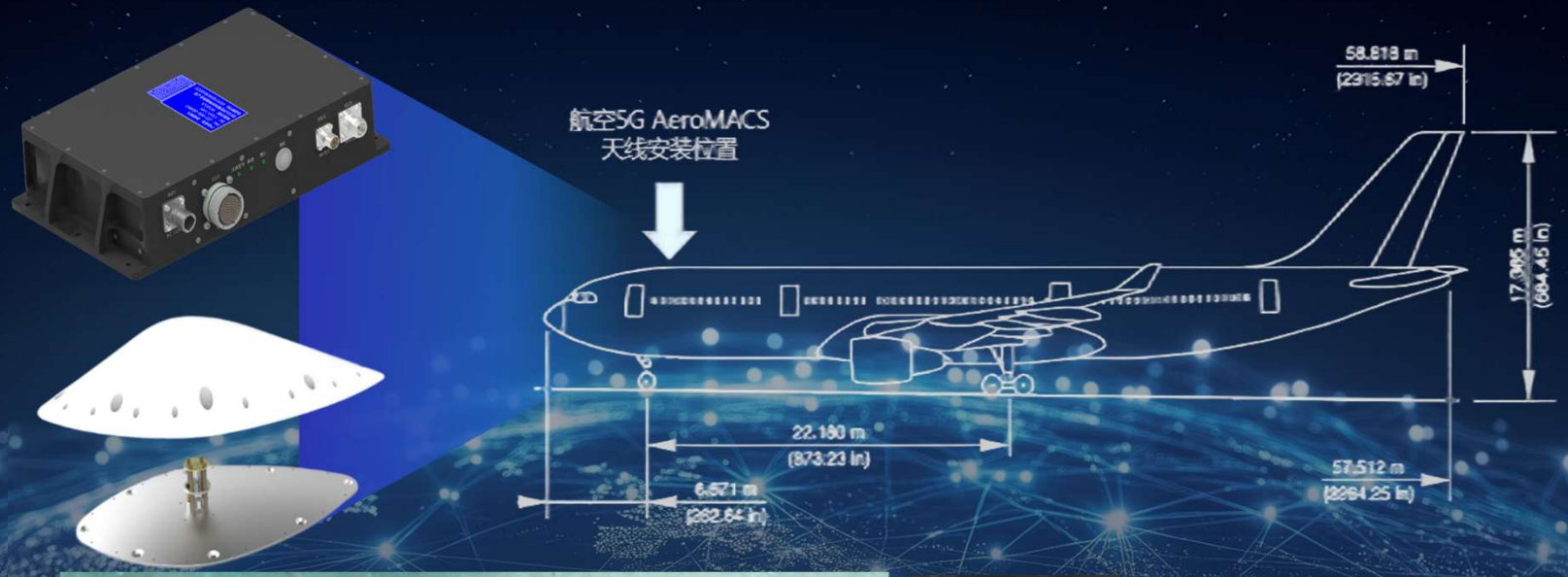


size

Device dimensions:
216*140*30mm (heat sink can be added; after installation, ≤230*140*50mm)

Terminal access equipment

STC Forensics of Airborne AeroMACS 2.0 Avionics Equipment



Terminal access equipment

Outdoor AeroMACS 2.0 terminal device (for use with cameras, multi-point/field monitoring systems, etc.)

3 Application of AeroMACS 2.0

AeroMACS 2.0 is highly suitable for airport surface operations

Three major advantages of applying AeroMACS 2.0 to airport surface operations

High bandwidth: 350 Mbps, low latency: 15 ms

High-bandwidth, low-latency wireless communication technology

Production-grade network interconnection for airport surface

Multiple organizations collaborate to provide air transport services. There is an urgent need to optimize business processes based on 5G. Different units and job types work together to support airports, airlines, air traffic control, aviation fuel, airline catering, etc.

Highly matched to surface operation collaboration scenarios

Supporting multi-stakeholder, full-element collaborative operations

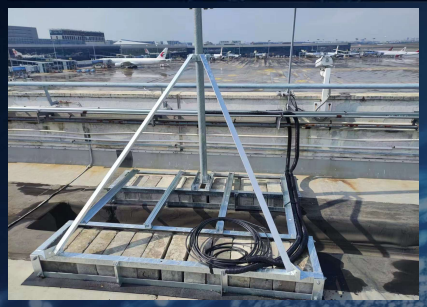
Dedicated frequency band 5091-5150 MHz.
5G public network frequency bands cause interference to some aircraft types, and signal coverage in taxiways and runways is incomplete. 2. The exclusive frequency band and dedicated air traffic control private network significantly enhance information security.

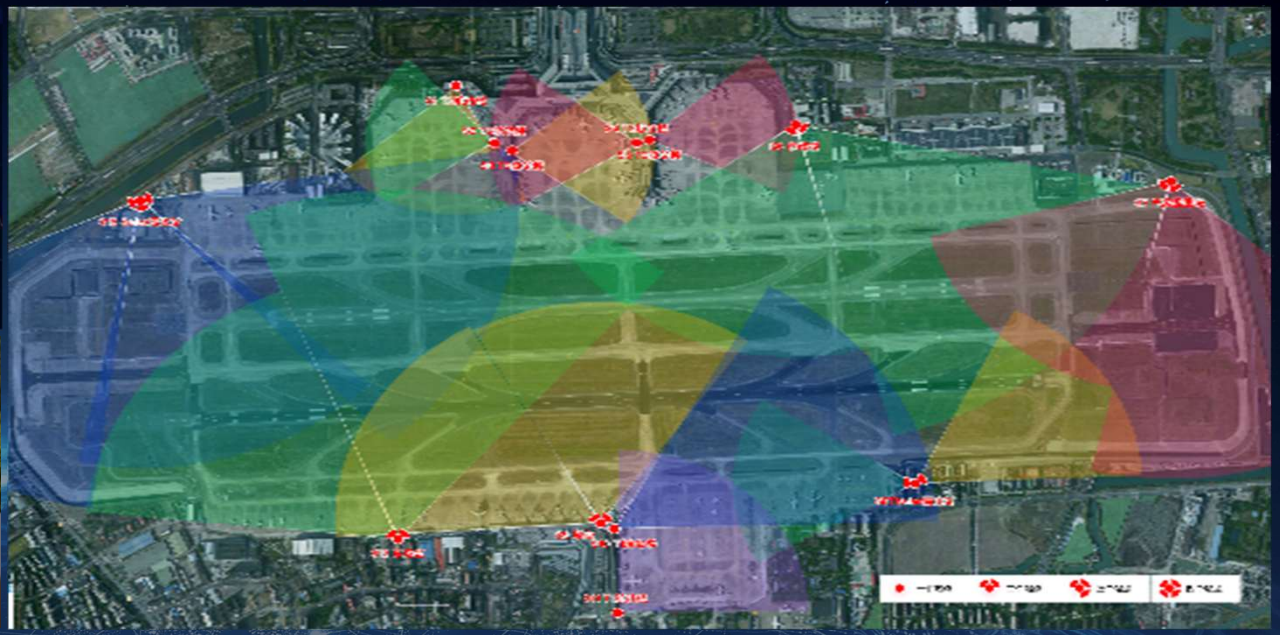
High security level

Meeting the security business requirements within the airport area

Shanghai Hongqiao International Airport (SHA)

Construction Status



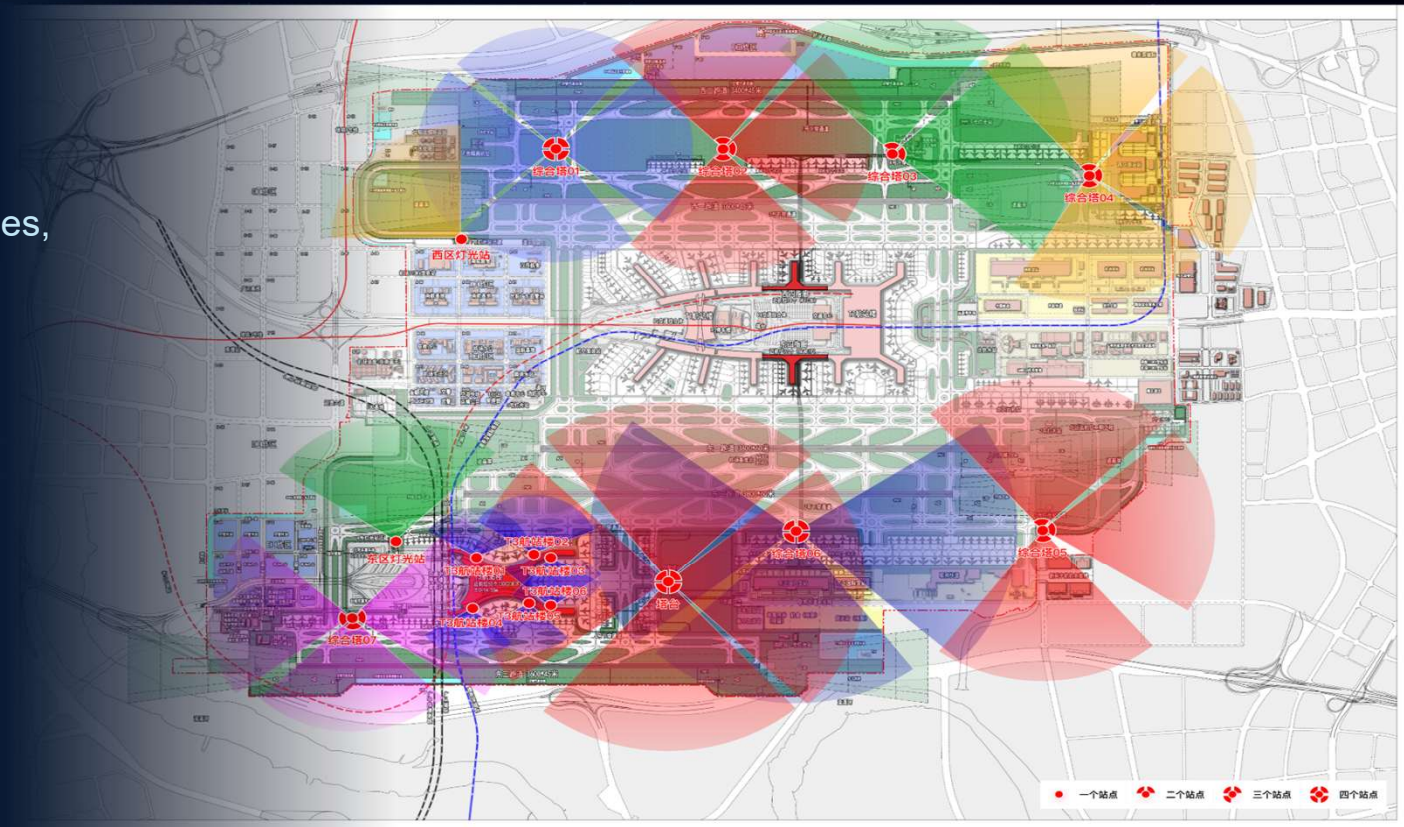


- 20 sets of aviation AeroMACS 2.0 ground stations completed
- Operational Systems Developed: Runway Incursion Prevention for vehicles, Visual Taxi Guidance, vehicle operations under Low Visibility Operations, and wireless control of Runway Status Lights (RWSL).
- Dec 2023: Network Construction & Tuning Completed
- May 2024: System Construction & Trial Readiness
- Jan 2026: Industry Acceptance Inspection

Guangzhou Baiyun International Airport (CAN)

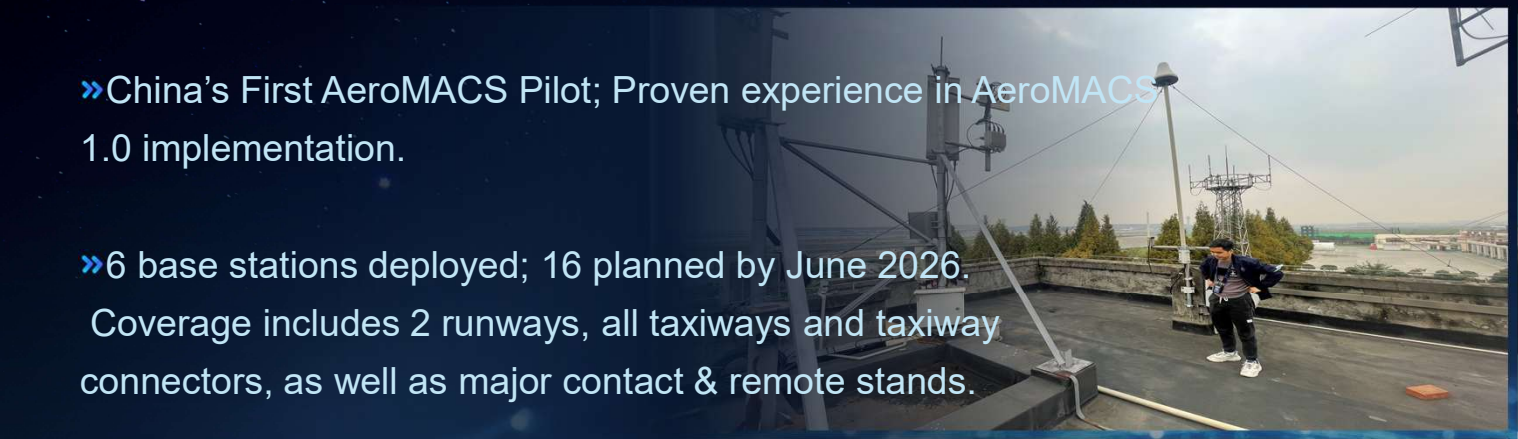
Construction Status

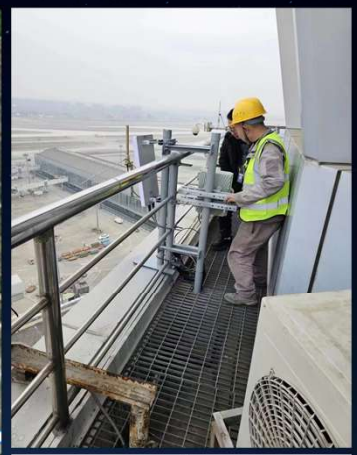
- 52 Outdoor Base Stations Fully Deployed
- Full Coverage: Movement Areas, MRO Zones, Vehicle Zones & Operational Areas
- Jul 2025: Deployment & Testing for Visual Taxi Guidance & Maneuvering Area Safety

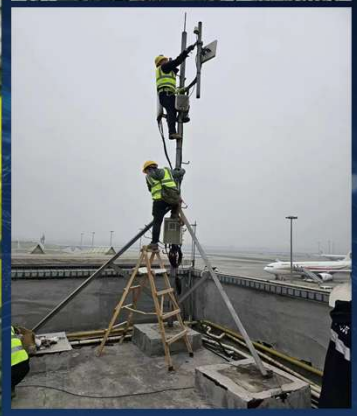


Chengdu Shuangliu International Airport (CTU)

Network Infrastructure Development







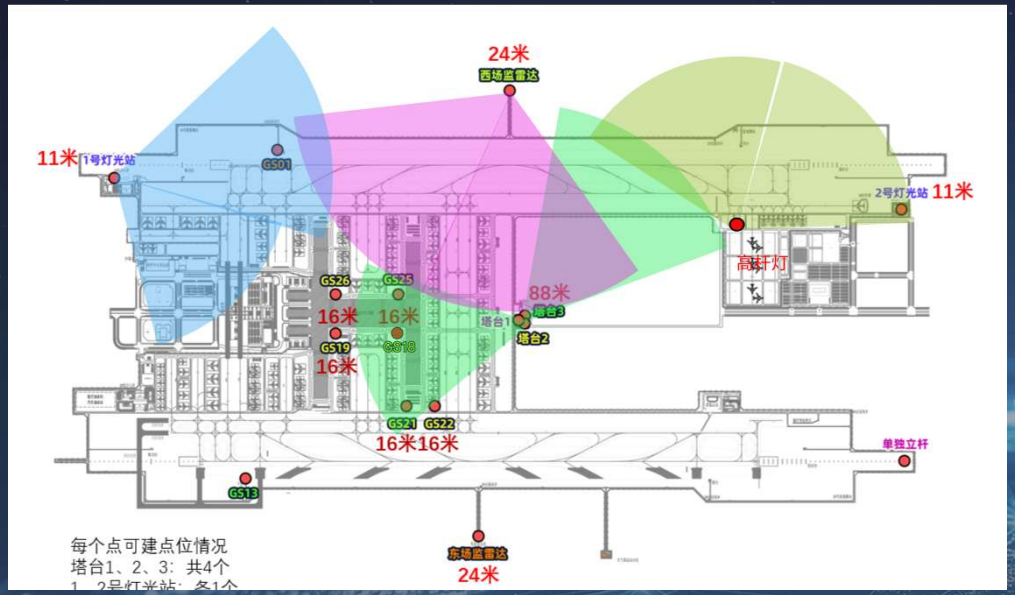
» China's First AeroMACS Pilot; Proven experience in AeroMACS 1.0 implementation.

» 6 base stations deployed; 16 planned by June 2026. Coverage includes 2 runways, all taxiways and taxiway connectors, as well as major contact & remote stands.

» Preparations underway for Efficient Aircraft Guidance, Aeronautical Data Sharing Platform, and Mobile ATC Tower Command systems.

Ezhou Huahu Airport (EHU)

Network Infrastructure Development



Airport-wide BS Deployment

» Focus on Maneuvering Areas & Aprons

3 Specialized Vehicles Retrofitted

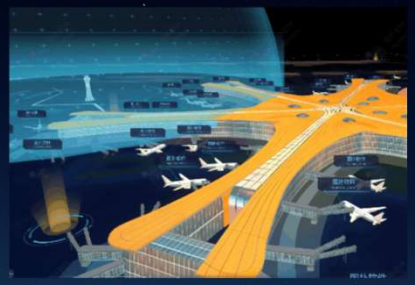
» 2 Bird-Scaring, 1 Airfield Patrol

Deployed Efficient Aircraft Guidance System, Runway Incursion Prevention System, and Bird Scaring Auxiliary System.

Application scenarios: centering on 'safety' and 'efficiency'

1
Visual aircraft guidance

2
Surface operation safety



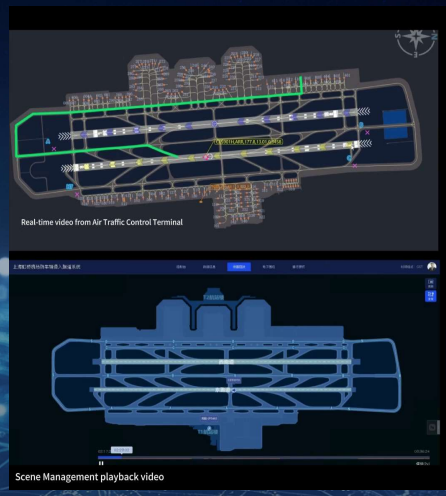
3
Airport apron resource management

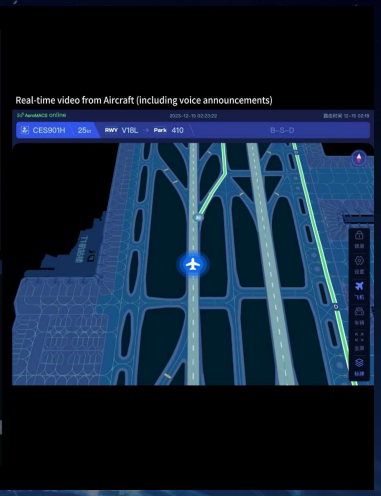
4
Smart interconnected airport operation network

5
Remote operation collaborative management

Visual taxi guidance system solution – Shanghai Hongqiao Airport

Real-time taxi guidance verification effects across three terminals: airport supervision, pilot, and ATC control





Tower issues digital taxi instructions

Onboard terminal

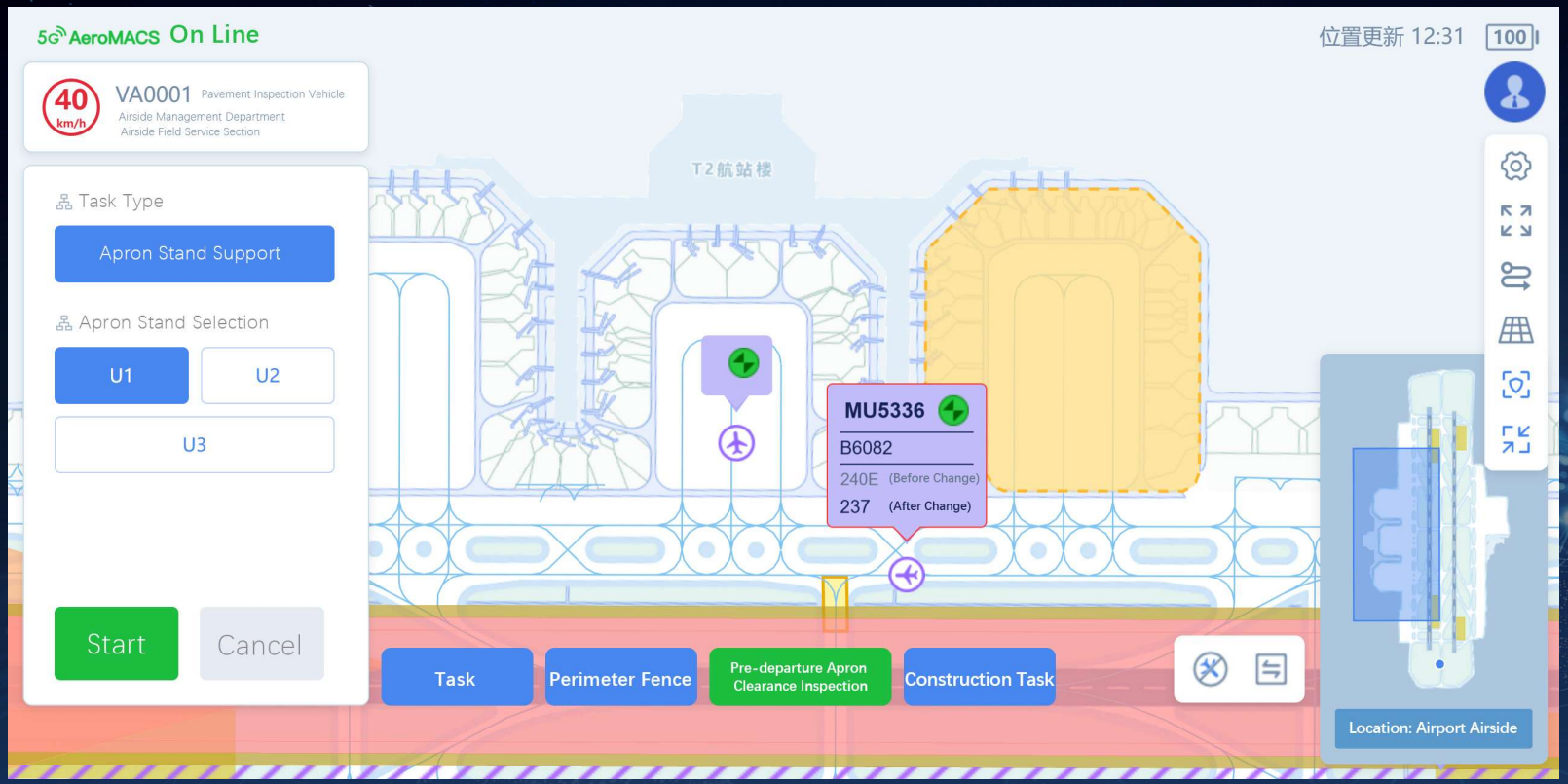
Visual taxi guidance

December 15, 2023 – World's first Application validation of 5G-based efficient aircraft taxi guidance

Visual taxi guidance deployed and verified at multiple pilot airports – Guangzhou Baiyun Airport

Guangzhou taxi guidance system

Follow-me vehicle visualization – Shanghai Hongqiao Airport

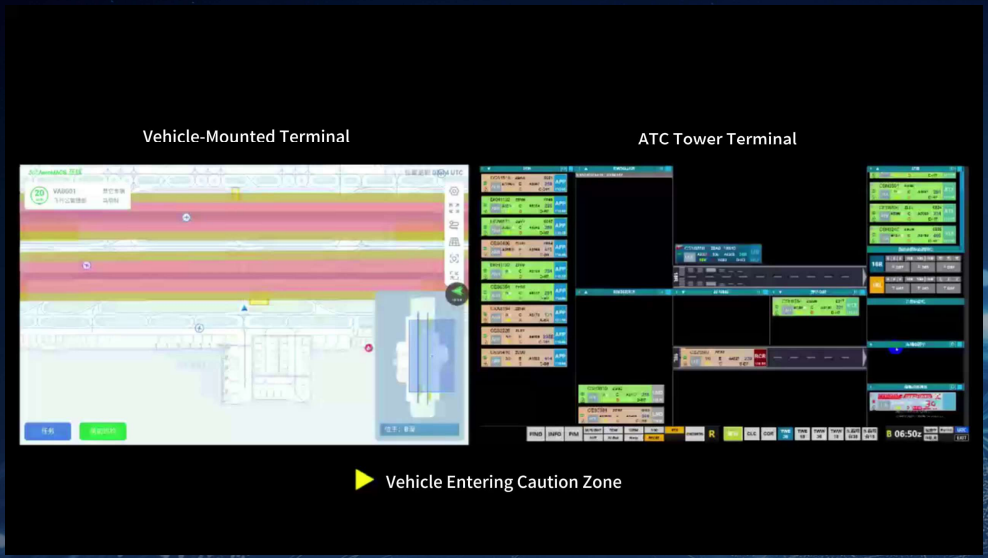


Outcomes

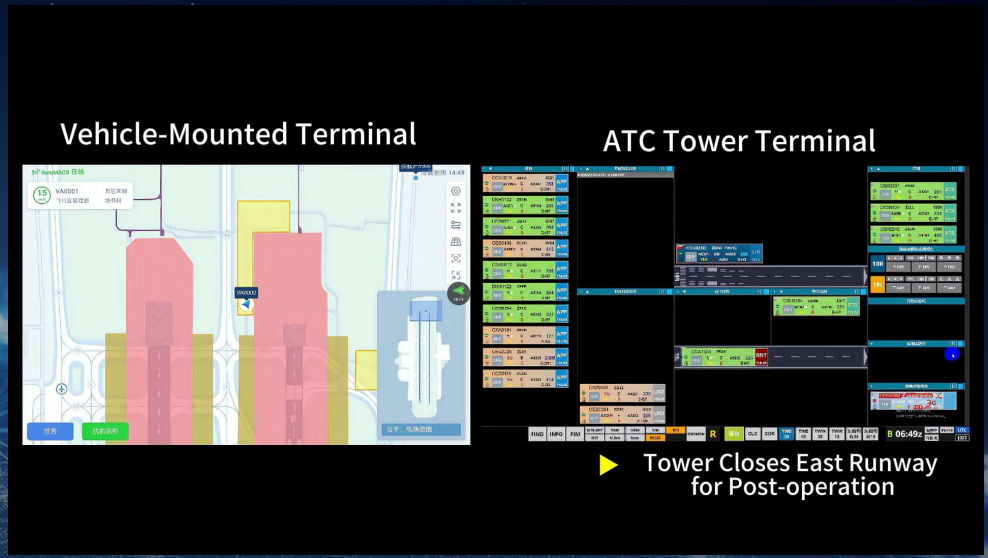
- Improved guidance efficiency
- Reduced operational risks
- Empowered frontline operations

Runway Incursion Prevention Application– Shanghai Hongqiao Airport

Alarm synchronization awareness



Runway availability status synchronization awareness



Operational situation (intent) synchronization awareness

AeroMACS 2.0 Runway Incursion Prevention– Shanghai Hongqiao Airport

Vehicle-Mounted Terminal

ATC Tower Terminal

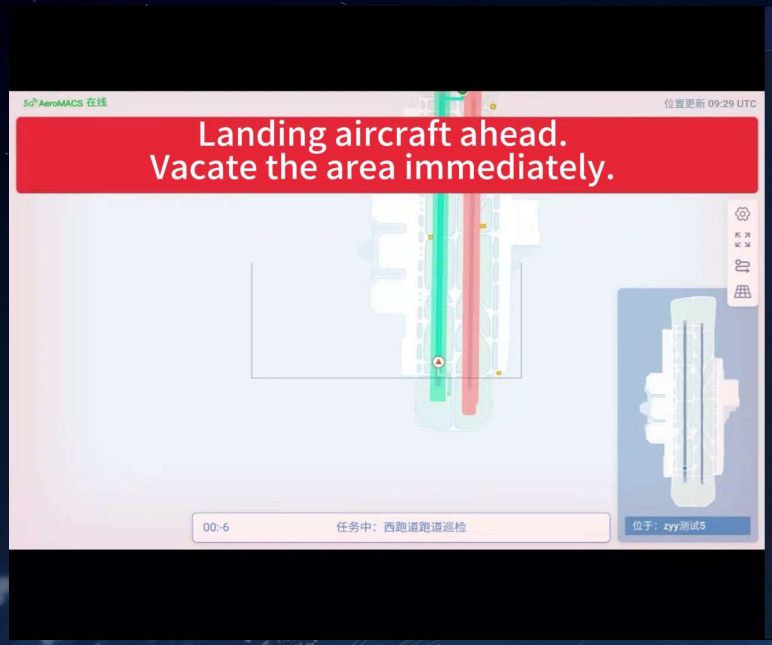
▶ Lead vehicle initiates runway inspection request in holding area

Real-time screen recording of digital instructions for runway inspection patrols

Runway Incursion Prevention System Core Functions – Shanghai Hongqiao Airport

After the pre-flight clearance inspection is completed, the electronic fence is activated.

Runway incursion prevention application effect– Shanghai Hongqiao Airport

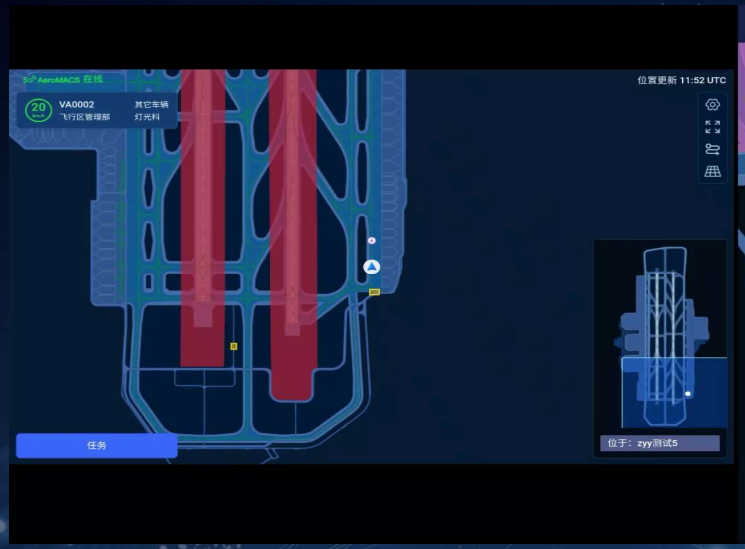


Active aircraft-vehicle relative position alert

Aircraft landing

Runway incursion prevention application – vehicle approaching aircraft alert – Shanghai Honggiao Airport

On board PAD



Airport supervision terminal

Active aircraft-vehicle relative position alert

Aircraft taxi safe distance

4 Challenges and Future of AeroMACS 2.0

Challenges

- The need for Multi-Stakeholder Collaboration:
- The validation of Execution Strategies:
- Safety Management of Onboard Systems
- The Scalability of the Ecosystem

Development Vision

- 1. focusing on Airborne Certification
- 2. accelerating Infrastructure Expansion。
- 3. broadening the Application Ecosystem
- 4. committed to Standardization

中国民用航空局 空中交通管理局
Air Traffic Management Bureau.CAAC

Thank You !

AeroMACS 2.0
AeroMACS based on 5G communication technology

for Q&A Please EMAL
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Equipment Maintenance Center , East China ATMB
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Shenzhen Bao'an International Airport (SZX)

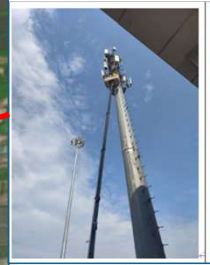
Test Network Deployment

ITC Building Operations Room

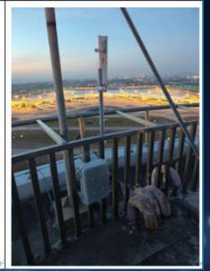
ITC Building Site Construction

Installation of indoor equipment rooms

Construction of Communication Pole for Satellite Station



Construction of Shenzhen Airport Tower Station



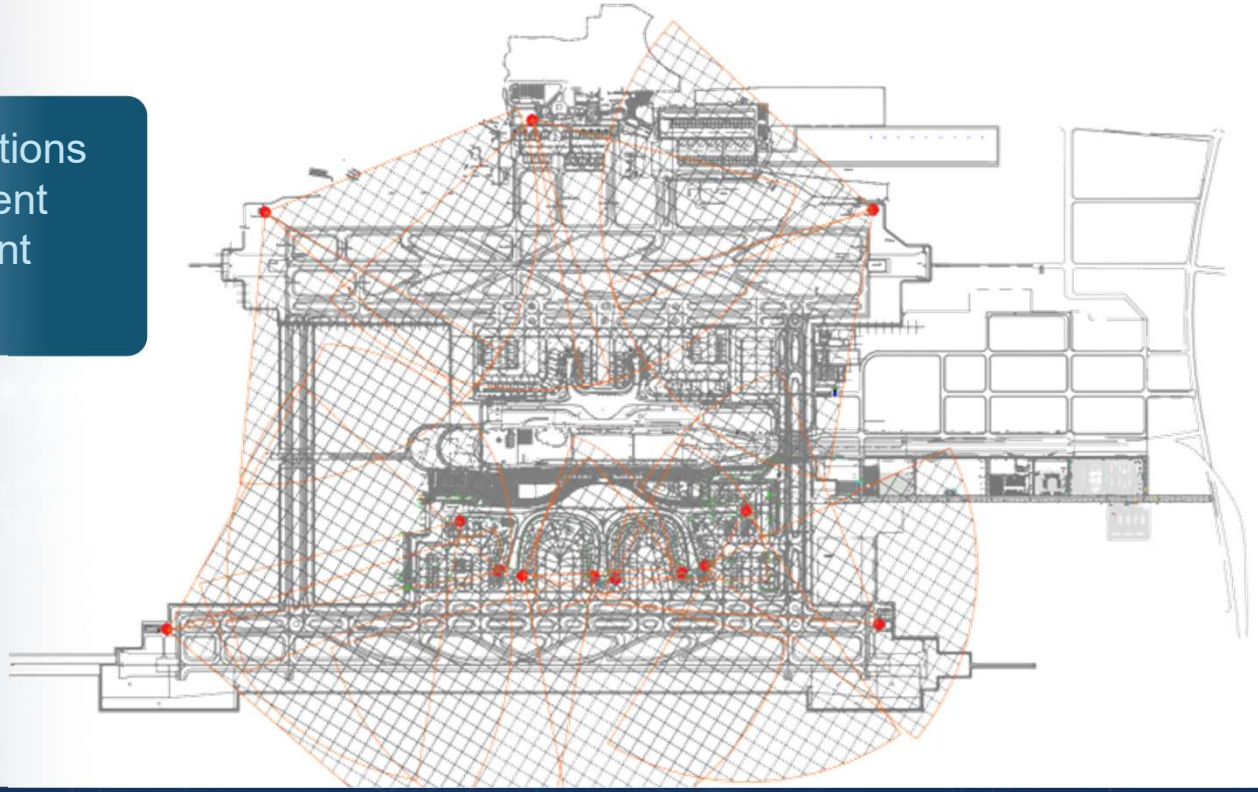
5 Aviation 5G Base Stations are constructed for "Key Technology Research and Demonstration Project for Intelligent Surface Operation and Control."

Base Stations deployed at the ITC building, ATC tower, and satellite concourse (communication poles).

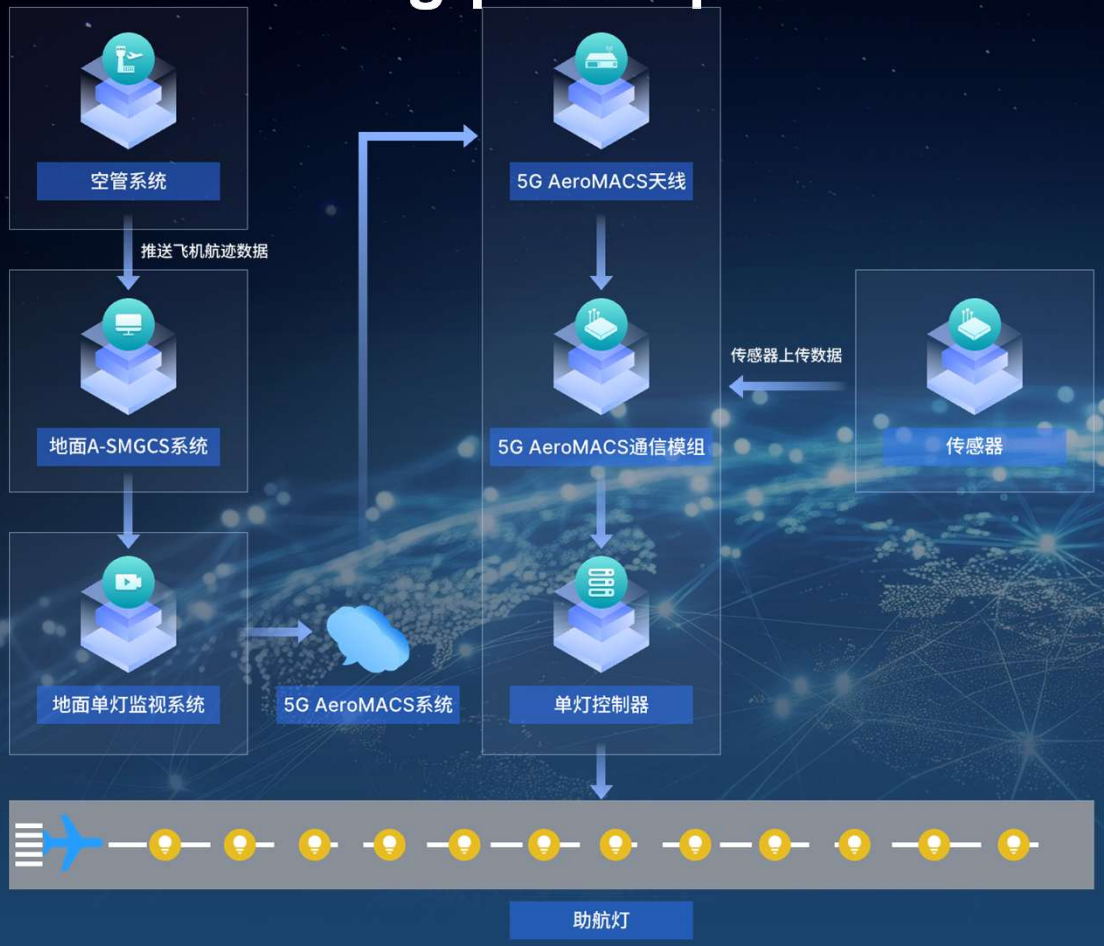
Nanning Wuxu International Airport (NNG)

Operational Network Deployment

Planned construction of **18 base** stations in 2026, covering all aircraft movement areas, MRO areas, vehicle movement areas, and staff operation zones.



Wireless Control of Airfield Lighting – Shanghai Hongqiao Airport



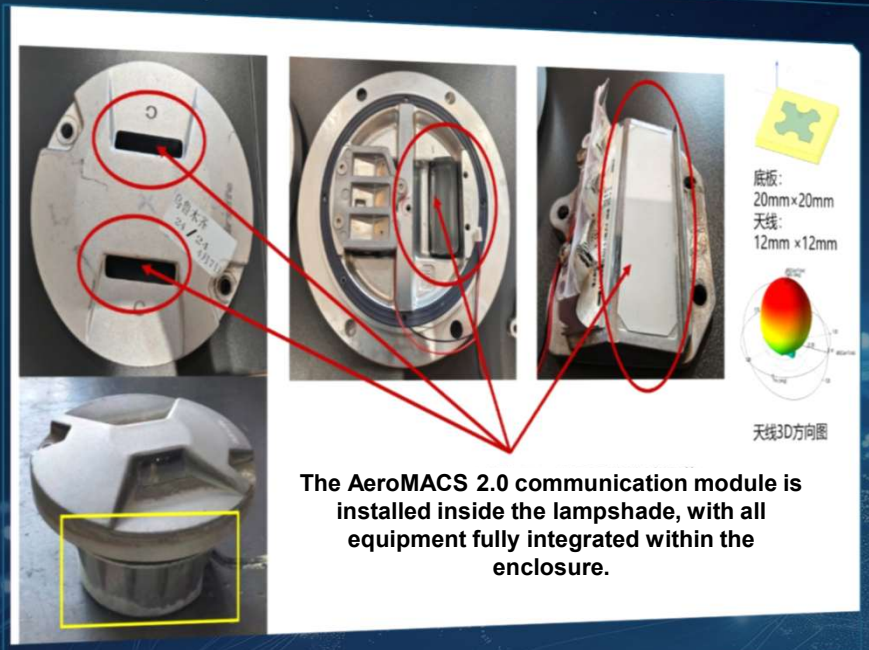
Objective

- To control airfield lighting based on the AeroMACS 2.0 private communication network, achieving "follow-the-green" progressive taxi guidance.

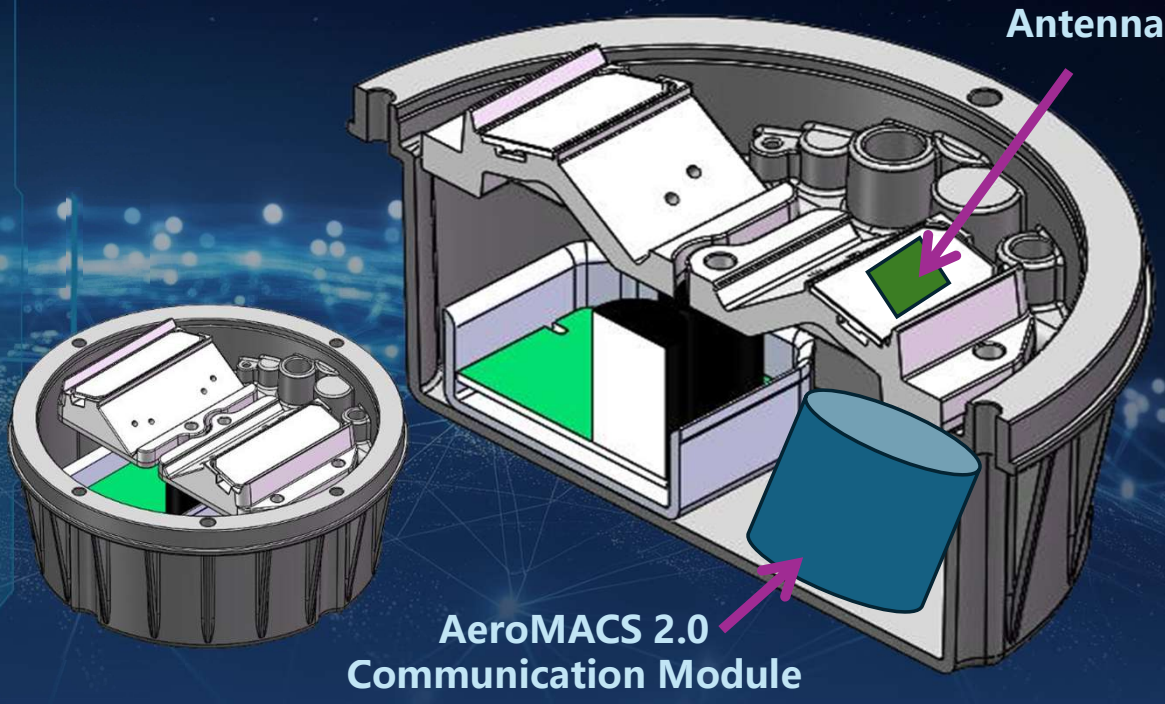
Design Concept

- Establish a dedicated airfield lighting control network based on AeroMACS 2.0 to fully ensure operational reliability.
- Upgrade the tower lighting control system and the Runway Status Light (RWSL) system with AeroMACS 2.0 communication capability.
- Retrofit existing airfield lighting in the maneuvering area without breaking the pavement or trenching and burying cables, thereby reducing construction complexity.

Wireless Control System Solution for Airfield Lighting – Shanghai Hongqiao Airport



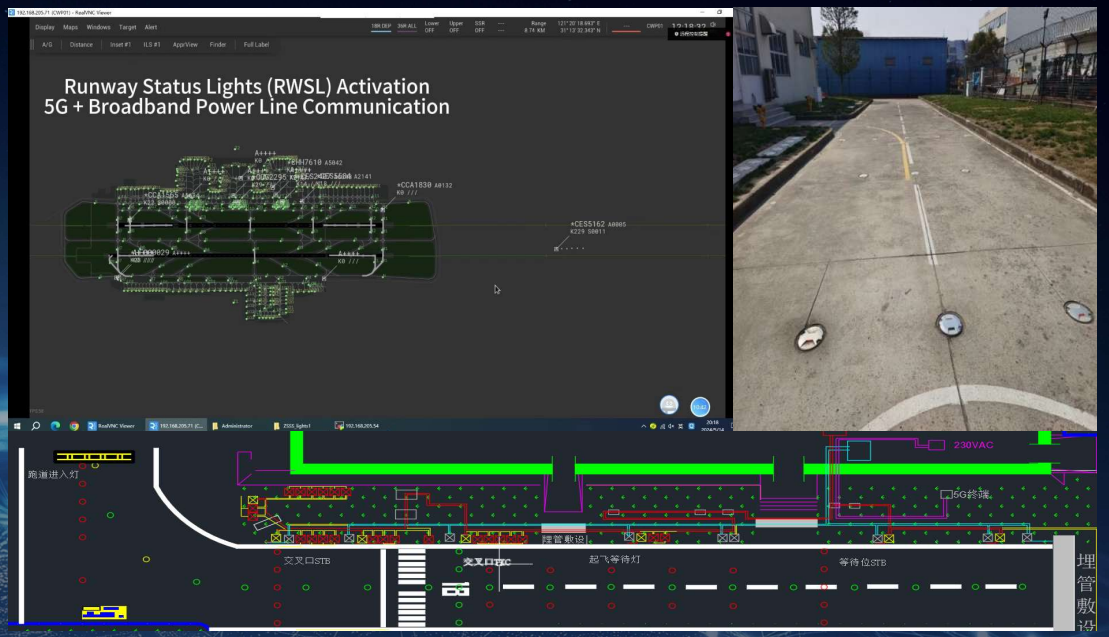
The AeroMACS 2.0 communication module is installed inside the lampshade, with all equipment fully integrated within the enclosure.



Wireless Control of Airfield Lighting – Shanghai Hongqiao Airport

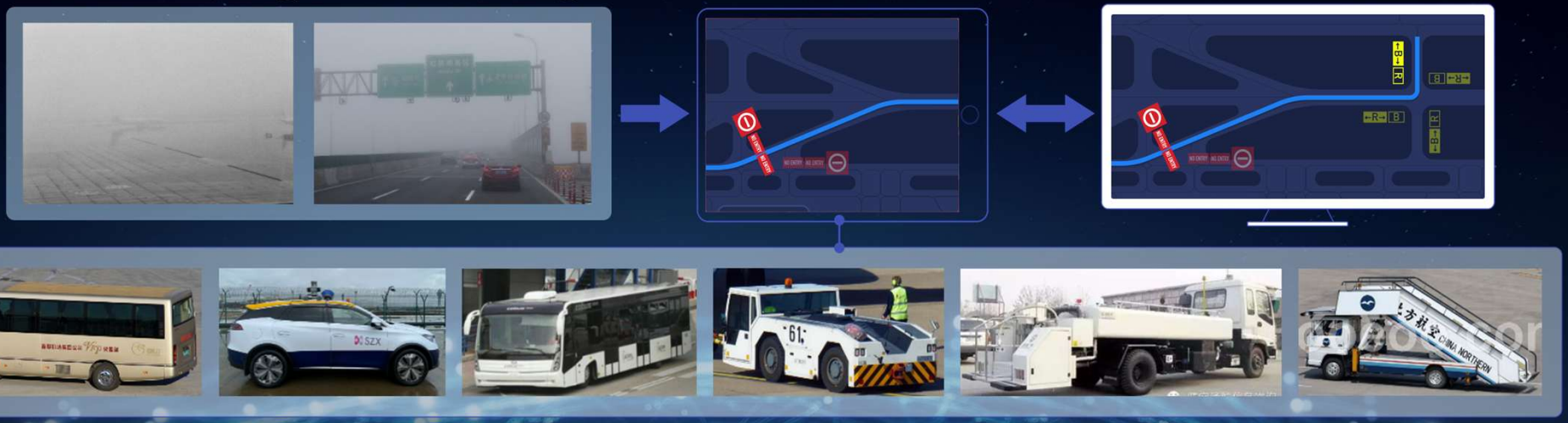
The distance between the test base station and the airfield lighting was approximately 1.8 km. The average communication delay of the AeroMACS 2.0-based airfield lighting control was 20 ms.

The AeroMACS 2.0 network supported normal operation of Runway Status Lights (simultaneous on/off of multiple lights) and path guidance (progressive on/off of centerline lights). The communication bandwidth was sufficient to meet airfield lighting communication requirements.



Validation Results at Shanghai Hongqiao Airport

Low Visibility Operation Solution – Path Planning and Navigation



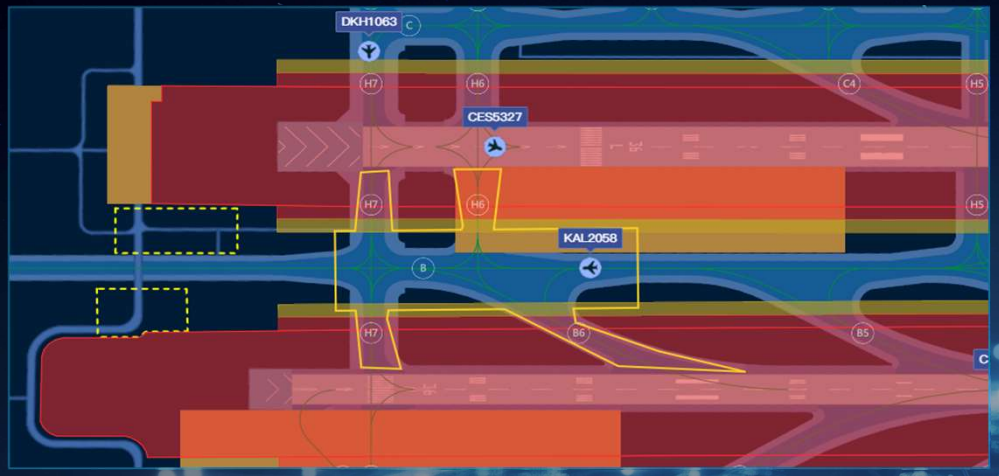
Objective

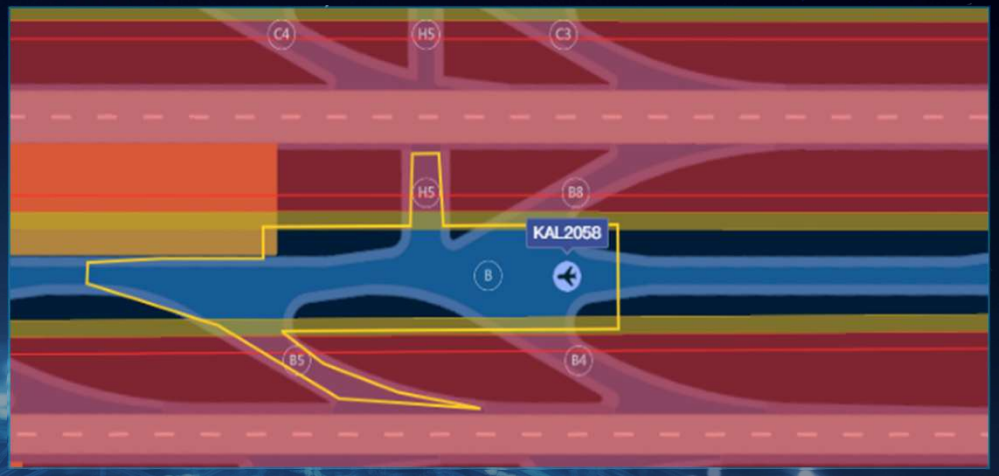
- Establish vehicle operational capability under low visibility conditions
- Establish coordinated surface aircraft-vehicle operational capability

System Construction

- Equip vehicles with high-precision positioning and high-frequency position reporting for airport surface operations
- Integrate high-precision airport digital maps, the AeroMACS 2.0 network, and a third-party data sharing platform to establish vehicle coordinated operation capability, situational awareness under low visibility conditions, and path planning and navigation capability

Low Visibility Operation Assistance – Aircraft Dynamic Geofencing Results





Objective

Based on AeroMACS 2.0 and air traffic control surveillance data, construct a dynamic geofence that follows aircraft movement, providing real-time distance alerts and conflict warnings to apron vehicles to prevent dangerous approaches and collisions.

Design Approach

- Data Fusion: Integrate data from the ATC surface surveillance system (radar, multilateration) and 5G on-board terminal data to accurately classify aircraft, vehicles, false targets, etc.
- Dynamic Geofencing: Based on aircraft operational status (taxiing/takeoff-landing/stationary) and position (runway/taxiway/apron), generate a geofenced alert zone that moves with the aircraft in real time.
- Conflict Alerting: Leverage high-precision, high-frequency vehicle positioning capabilities to perform real-time conflict detection and analysis, trigger audible and visual alerts to all relevant terminals, and assist in conflict resolution and avoidance.

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Taxi into Apron 3

Pass by Apron 3

Active aircraft-vehicle relative position alert

Give way to aircraft at the STOP line