



# Thoughts on the integrated operations between manned aircraft and UAS

**Reporter: Prof. & PhD Weijun Pan**

**College of Air Traffic Management  
Civil Aviation Flight University of China(CAFUC)**

**10<sup>th</sup> May , 2023**

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- 1 Background**
- 2 Practices by CAFUC**
- 3 Thoughts & Outlook**

# 1. Background

- Unmanned Aircraft System(UAS) refers to the aviation vehicle without pilot onboard and usually manipulated by an VLOS operator or controlled by a remote pilot in the ground control station.
- The large class UAS will be piloted remotely to integrate into national airspace. However, how to integrate smaller-sized UAVs into the airspace where manned aircraft fly is still unresolved.

CAAC classifies UAS according to their maximum take-off weight

**Miniature**

**Light**

**Small**

**Medium**

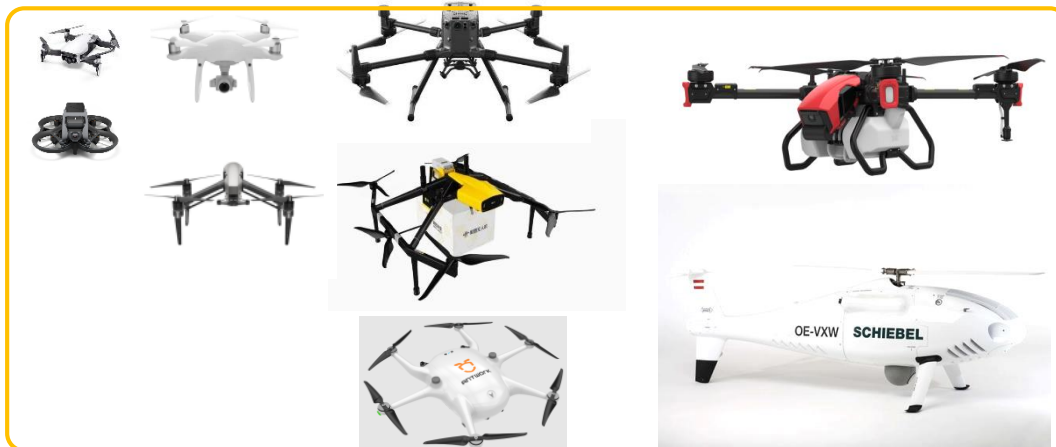
**Large**

0.25kg

7kg

25kg

150kg



**How to integrate into NAS?**



**RPAS**

# 1. Background



## □ US: UAS integrated into National Airspace System

DOT, DoD, DOC, DHS, NASA and FAA partner agencies and representatives of multiple next-generation air transportation systems participate in the UAS integration effort.

## □ EU : released the "Drone Strategy 2.0" to promote the integration of drones

The strategy envisages that by 2030 many drone services, including air traffic services, will be part of European life, with air cabs providing regular transport for passengers, possibly initially with pilots, but with the ultimate goal of fully automated operations.

International Civil Aviation Organization  
WORKING PAPER  
ASSEMBLY — 40TH SESSION  
TECHNICAL COMMISSION  
Agenda Item 30: Other Issues to be considered by the Technical Commission  
UAS TRAFFIC MANAGEMENT  
(Presented by International Coordinating Council of Aerospace Industries Associations (ICCAIA), Airports Council International (ACI), International Federation of Air Line Pilots' Associations (IFALPA) and International Federation of Air Traffic Controllers' Associations (IFATCA))  
EXECUTIVE SUMMARY  
Fundamental principles of aviation are being challenged by new entrants into aviation. In particular, unmanned aircraft systems (UAS) including small commercial drones, urban air mobility (UAM) and high-altitude pseudo-satellites (HAPS). UAS traffic management (UTM) is the enabler for new operations ranging from very low to very high altitude. This working paper outlines key considerations for States, relating to UAS and UTM operations, whilst identifying actions for ICAO building upon their "UTM - A Common Framework with Core Principles for Global Harmonization" document that was released in early 2019.  
Article: The Assembly is invited to:  
a) request the Council to urge States to establish a framework for UTM operations based on the ICAO document "UTM - A Common Framework with Core Principles for Global Harmonization" and further updates to that document;  
b) request the Council to urge States to implement authoritative and validated digital data sources for UTM providers and UAS operators;  
c) request the Council to urge States to ensure alignment of risk profiles between manned and unmanned aircraft operating in shared airspace and use a common risk assessment methodology for UAS operations and UTM operations within their airspace;  
d) instruct the Secretary General to identify which panels and/or groups are tasked with addressing integrated operations in all airspace classes and strata (low/medium/high). This should include a focus on the "trust" requirements for increasing levels of autonomy; and  
e) instruct the Secretary General to identify appropriate industry standards that States should apply with regards to UAS and UTM software and hardware.  
Strategic Objectives: This working paper relates to all Strategic Objectives.  
Financial Implications: The activities referred to in this paper will be subject to the resources available in the 2020-2022 Regular Programme Budget and/or from extra budgetary contributions.  
\* Arabic, Chinese, English, French, Russian and Spanish versions provided by ICCAIA.

## UAS-NAS

### Stakeholder Feedback Report

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## UAS Integration in the NAS Project: Overview of Flight Test Series 6

Michael L. Marston  
Clancy JC  
Armstrong Flight Research Center, Edwards, California  
Alexander D. Flock  
Millennium Engineering  
Armstrong Flight Research Center, Edwards, California  
Victor M. Loera  
American Systems Corporation  
Armstrong Flight Research Center, Edwards, California  
Sam K. Kim  
Armstrong Flight Research Center, Edwards, California  
Michael J. Vincent  
Langley Research Center, Hampton, Virginia  
Minghong G. Wu and Conrad Barle  
Ames Research Center, Moffett Field, California  
Wayne W. Bridges  
Flight Research Associates  
Ames Research Center, Moffett Field, California  
Wei-Ching Wang  
Universities Space Research Association  
Ames Research Center, Moffett Field, California  
July 2020

## Department of Defense Unmanned Aircraft System Airspace Integration Plan

Version 2.0  
March 2011  
Prepared by:  
UAS Task Force  
Airspace Integration Integrated Product Team  
This plan supersedes the 2004 "OSD Airspace Integration Plan for Unmanned Aviation".  
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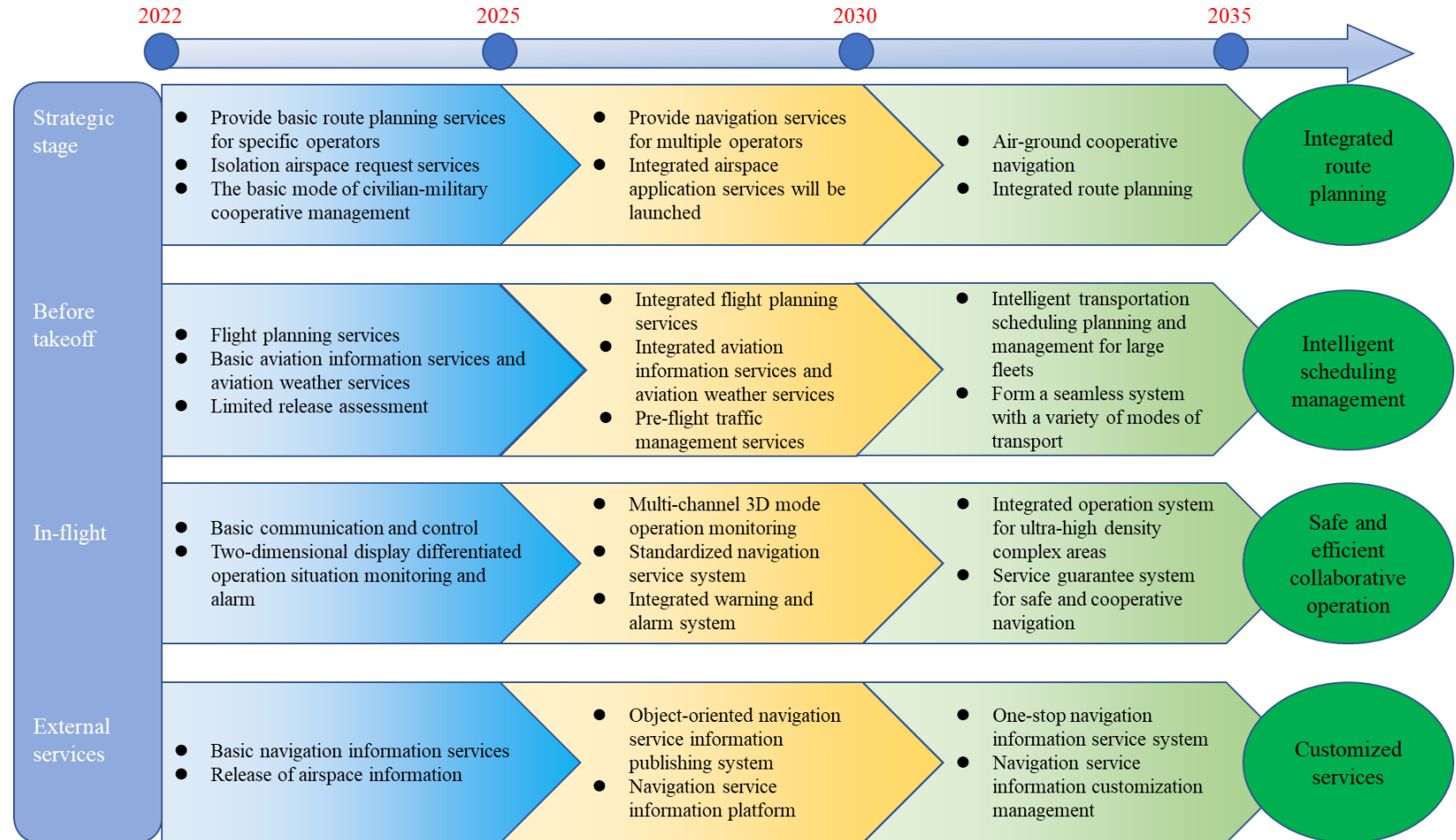
Brussels, 29.11.2022  
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COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS  
"A Drone Strategy 2.0 for a Smart and Sustainable Unmanned Aircraft Eco-System in Europe"  
{SWD(2022) 366 final}

# 1. Background

□ China : Releases "Guidance on Promoting the Development of Civilian Unmanned Aerial Vehicles (Draft for Comments)" to Promote the Integrated Operation of UAVs and MAVs

## □ Principle

- **Ensure safety**
- **Classification management**
- **Innovation-driven**
- **Open integration**



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## 2. Practice by CAFUC——Zigong Airport



### □ Jointly Build Civil Unmanned Aircraft Test Area with Zigong City

- In 2020, Zigong airport was approved the first round Unmanned Civil Aviation Test Areas by CAAC in the support of CAFUC.
- In 2021, CAFUC and Zigong established **Jointly Laboratory of Safe Operation for UAV Logistics on Feeder Line**



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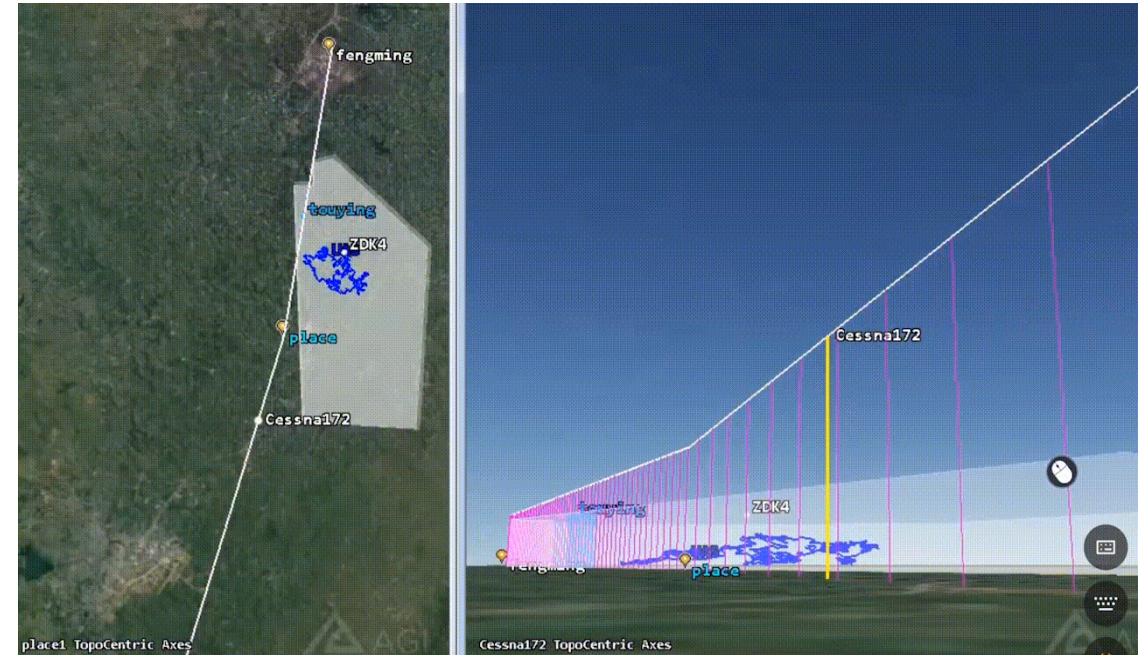
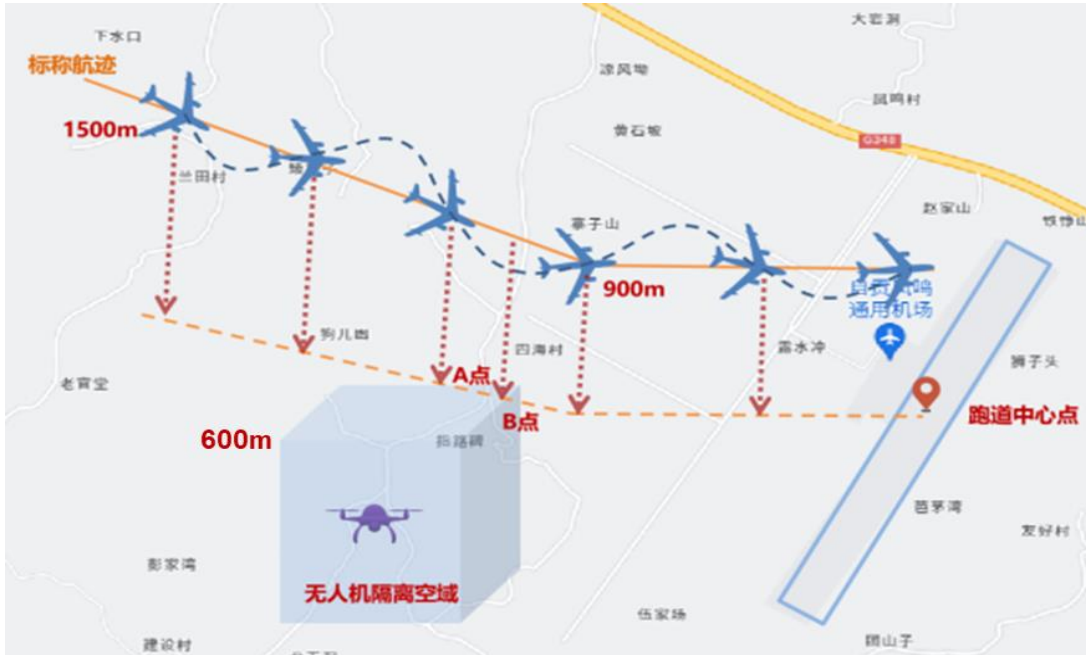


MAV/UAV integrated operation project laboratory

# 2. Practice by CAFUC —— Zigong Airport

## □ Specific Operation Risk Assessment for a specific scenario

- On the west side of the runway of Zigong Airport, there is a segregated airspace specially used for UAV test. This test airspace is below the manned aircraft approach route;
- We must evaluate air risk——whether the height separation between the upper boundary of the UAV's segregated airspace and the approach route of manned aircraft is enough



A typical scenario that UAV' s segregated operation airspace in a terminal area

# 2. Practice by CAFUC — Zigong Airport

## □ Specific Operation Risk Assessment for a specific scenario in Zigong Airport

- the collision risk probability was calculated when the unmanned aircraft was within a defined horizontal motion boundary and maintained a vertical interval of 300 meters with the manned aircraft.
- the probability of collision risk is  $2.89 \times 10^{-8}$  times per ten thousand hours, meeting the safety requirements of general aviation.

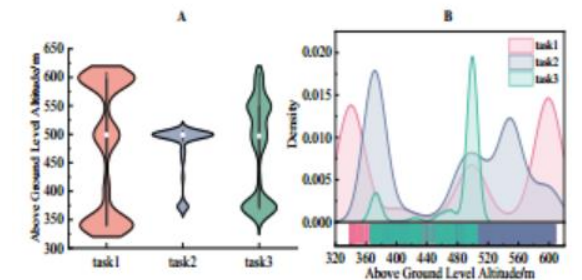
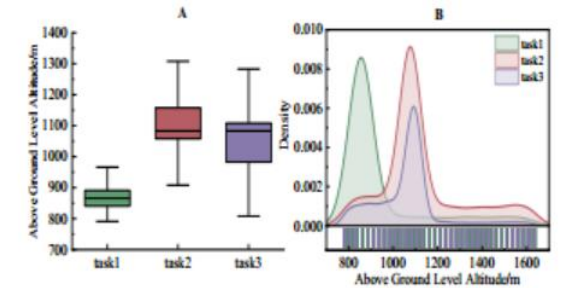
total air collision probability calculation

$$P = n\lambda \int_0^T P_V P_H$$

$$P_V = \int_{x_0}^{x_1} \int_{h_0}^{h_\infty} f(h)F(h, \delta)dhdx$$

$$P_H = (D_A + D_B + \delta_A + \delta_B)E(V)T\rho$$

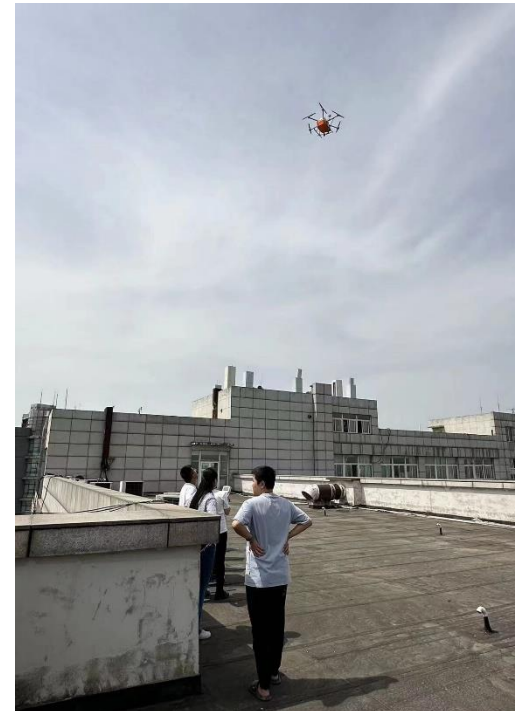
$$E(V) = \int_{v_1} \int_{v_2} \int_0^{2\pi} (v_1^2 + v_2^2 - 2v_1v_2 \cos \theta)^{\frac{1}{2}} p_\theta(\theta) p_v(v_1) p_v(v_2) d\theta dv_1 dv_2$$



## 2. Practice by CAFUC

### □ Jointly Build a laboratory in the field of intelligent air traffic

- The dean of the College of Air Traffic Management, Pan Weijun , on behalf of CAFUC, signed a contract with Antwork to build a joint laboratory of intelligent air traffic.
- Antwork donated two sets of logistics drones and their landing platforms to CAFUC, which were allowed to operate in the campus.

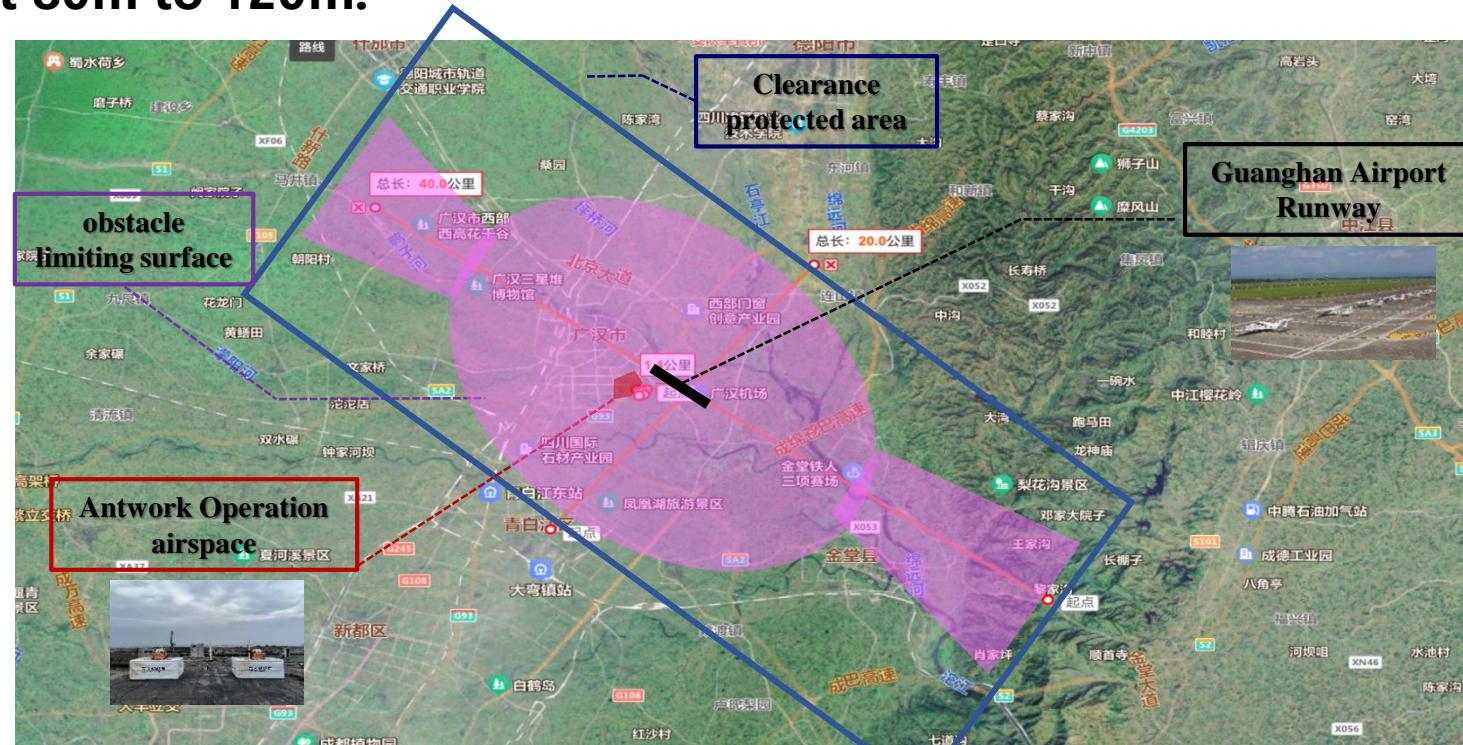


# 2. Practice by CAFUC



## Antwork will operate in the clearance protected area of Guanghan Airport

- The landing platforms of Antwork are placed on the roof of the third teaching building in the campus, sharing the airspace with the drone operator training for AOPA.
- The airspace below 50 meters is the airspace for drone operator training. The typical route height of Antwork is about 80m to 120m.



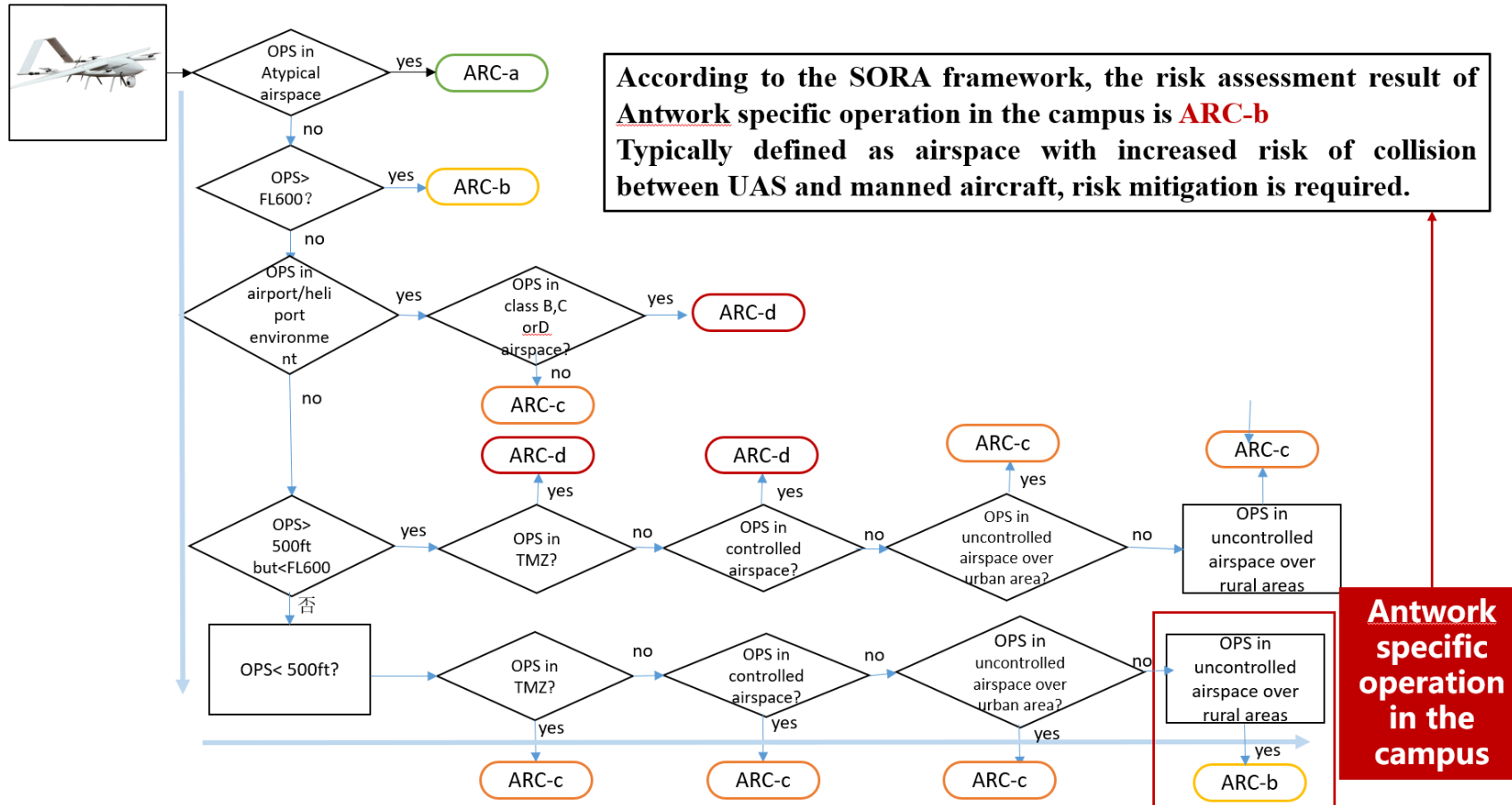
Antwork and AOPA' s drone pilot training activity share the low-altitude airspace with manned aircraft of Guanghan branch

# 2. Practice by CAFUC



## □ Antwork operation airspace in the clearance protected area of Guanghan Airport

- Antwork specific operation in the campus is ARC-b. So we will enhance surveillance capabilities with colleagues at Guanghan Airport for the UAV operation in our campus



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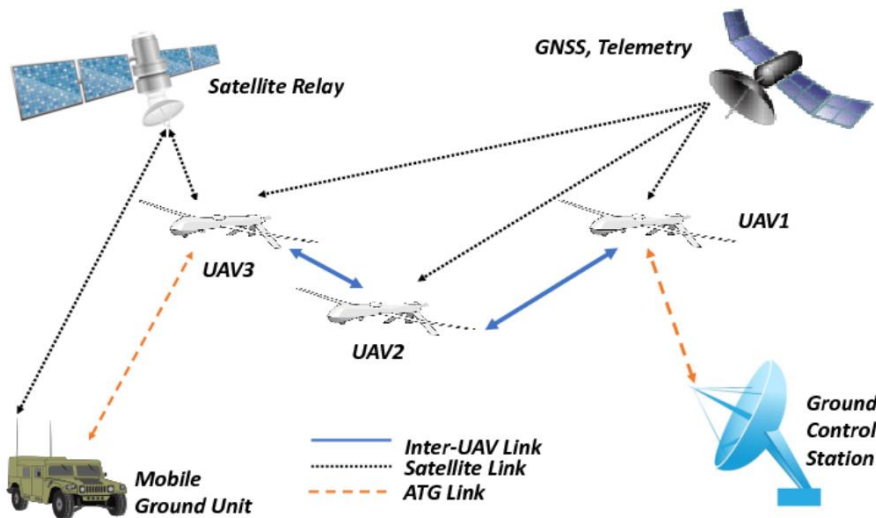
# 3. Thoughts & Outlook



## □ Problems in MAV/UAV integrated operation

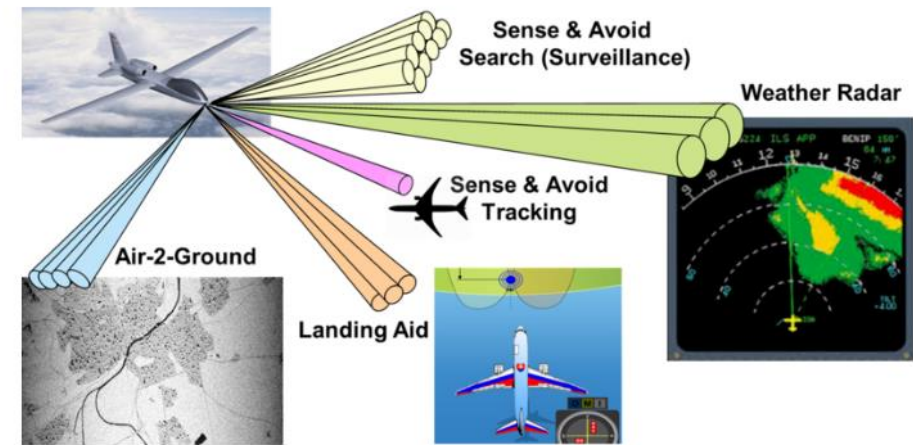
- Communication link

The links of UAVs differ greatly, and most of them do not have ATC business communication capabilities.



- Autonomous Security Sense-Avoid Capabilities

UAVs have difficulties in situational awareness of complex airspace, most UAVs currently lack the ability to maintain autonomous safety in the air and the ability to deconflict in the air.



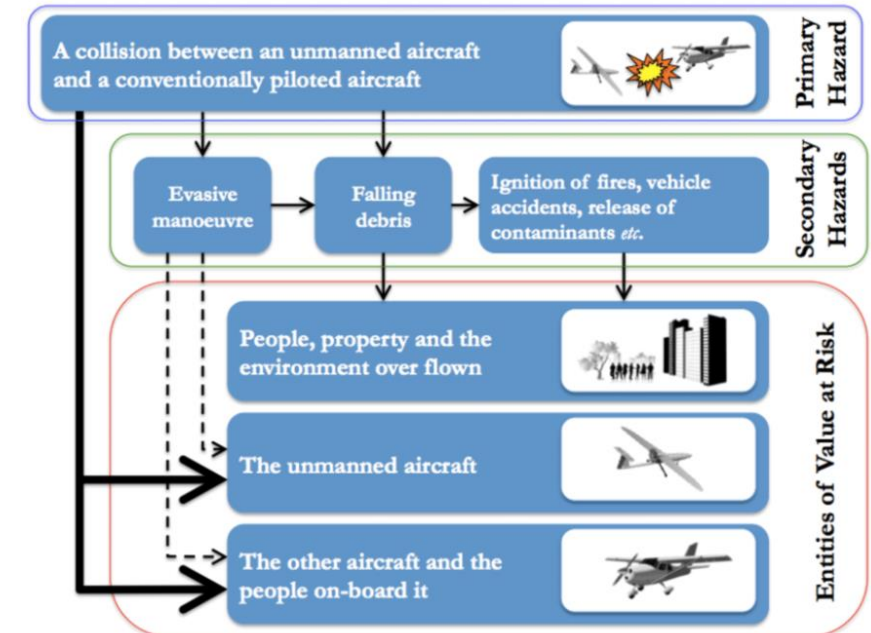
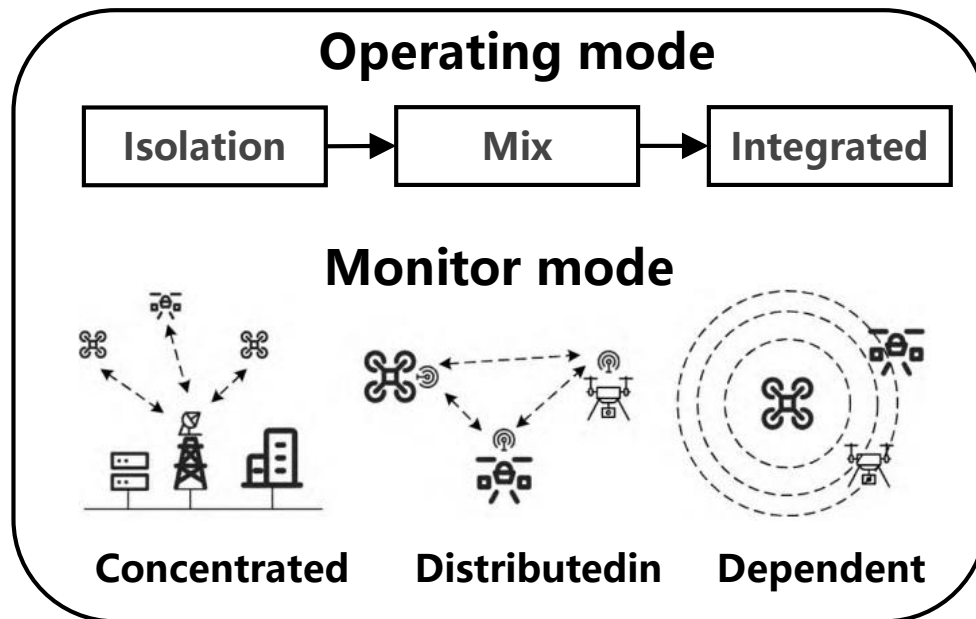
# 3. Thoughts & Outlook

## □ Problems in MAV/UAV integrated operation

- Integrated operation management and control mode
- Integrated control and risk monitoring

The overall concept and access requirements for how exactly to carry out integrated operation and the operation mode are unclear at present.

The operational safety risk of the UAVs have not been quantitatively assessed, it is impossible to know exactly whether the operational risk is acceptable.



# 3. Thoughts & Outlook



## MAV/UAV integrated operation gradually standardized (China)

时间	发布单位	法规名称	编号
2013年11月18日	中国民用航空局飞行标准司	《民用无人驾驶航空器系统驾驶员管理暂行规定》	AC-61-FS-2013-20
2015年12月29日	中国民用航空局飞行标准司	《轻小无人机运行规定（试行）》	AC-91-FS-2015-31
2016年7月11日	中国民用航空局飞行标准司	《民用无人机驾驶员管理规定》	AC-61-FS-2016-20 R1
2016年9月21日	中国民用航空局空管行业管理办公室	《民用无人驾驶航空器系统空中交通管理办法》	MD-TM-2016-004



## Automated management and control of manned-machine-drone integrated operation

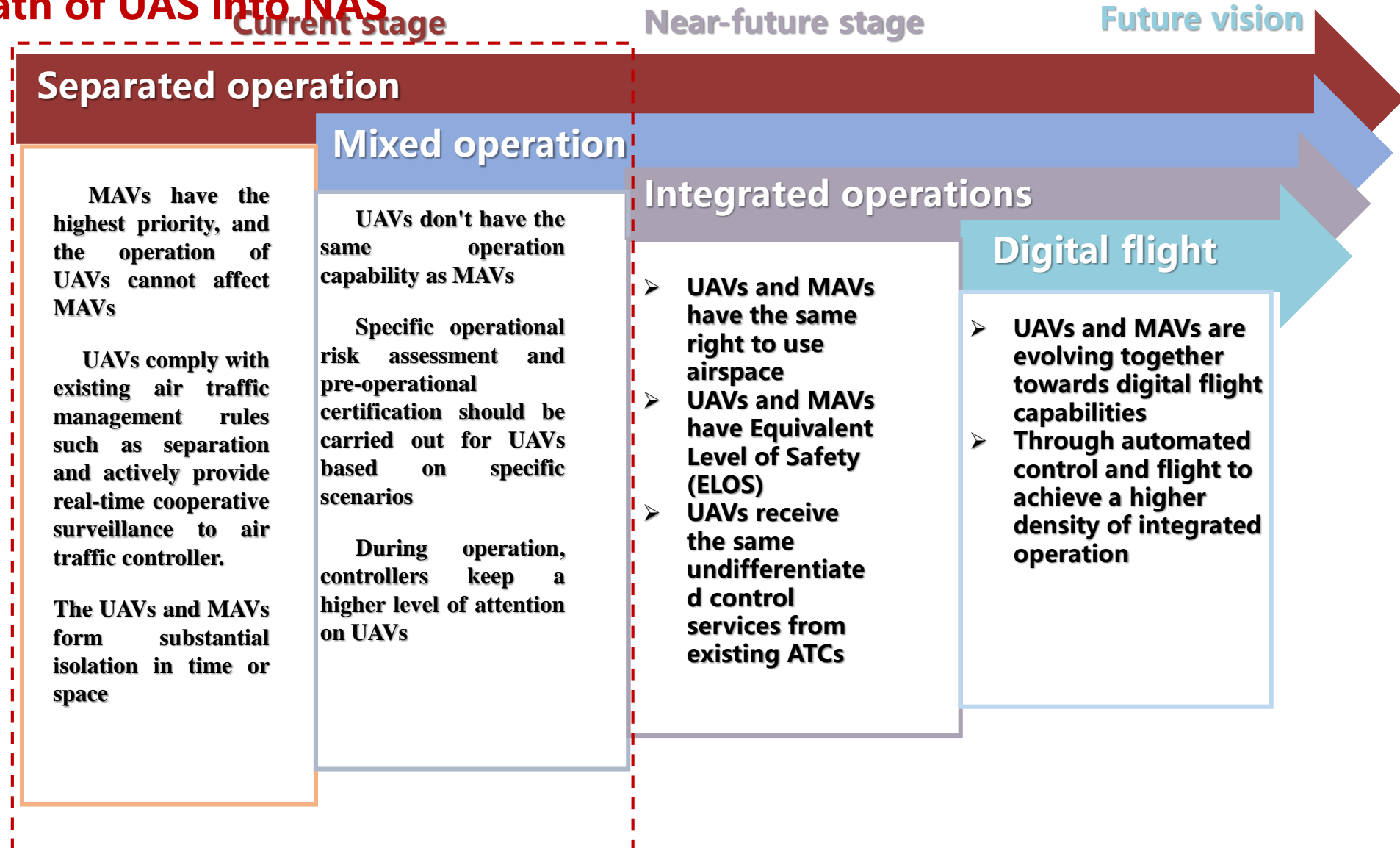
Low-altitude UAVs should be constructed with different levels of automated collision avoidance strategies:

- Coordinated avoidance based on cooperative communication surveillance
- Active avoidance based on established rules
- Autonomous sensing avoidance under non-cooperative conditions

# 3. Thoughts & Outlook



## □ The development path of UAS into NAS



# 3. Thoughts & Outlook



## □ Outlook

- For MAV/UAV integrated operation in the future, relevant policies and regulations should be improved, standard systems should be established;
- The distributed architecture and automated capabilities enable flight densities and operational rhythms that cannot be achieved with existing operating models to support new types of aircraft and enhance the utilization of underserved airspace such as low and ultra-high altitudes.



- Air traffic scalability
- Flexibility of operation
- Compatibility with the autopilot program
- Predictability of operation



**Thanks for listening!**