

# Imminent changes of ATM Automation System based on

# 4D&TBO

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# **Trajectory based Operation (TBO)**

TBO is the tendency and crucial part of the air transport development, combining advanced Flight Management Systems (FMS) with ground automation systems to manage aircraft position and timing.



- Air-to-Ground information sharing
- Promote collaboration among aviation business units and seamless track management
  - Optimal trajectory planning
- Improve the operation quality of ATC system and
  - solve arrival management and air traffic flow

management problems





# **Trajectory based Operation (TBO)**

TBO cannot make a qualitative change to the air transport. However, it can gradually promote all aspects of air transport development.





# **Core of TBO - 4-Dimensional Trajectory (4DT) Prediction**



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### **Role of ATM Automation System in TBO**





## **Facing changes for ATM Automation System**





# ATM Automation System will be facing ...

#### **TBO** operation environment

- Non-TBO capable aircraft
- Less-TBO capable aircraft
- > Most-TBO capable aircraft
- > All-TBO capable aircraft



- Voice or digital control ?
- Choose which aircraft to

#### control?

Dynamic route planning?



## **Progress of ATM Automation System changes**

- Mixed ability of scene
  recognition
  - CPDLC control operation
  - ADS-C data processing
  - Fixed point queue management
- RTA settings

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**Traditional** 

ATC system

 Extended analysis and evaluation

- Ground equipment can receive 4DT data through ADS-C, including EPP and ETA windows;
- AMAN system calculates the CTA at the fusion point with an accuracy of ±10 s;
- Upload and modify the CTA via CPDLC;
- Using ground network connection to realize the interaction of track information between control units;
- Ground management tools fully apply EPP to achieve dynamic airspace management, consistency monitoring, traffic sequencing, conflict detection and liberation.

# The Changes of ATM Automation System

#### Basis

- Capable of G-A communication
- Capable of digitalized control
- Equipped with flight flow decisionmaking tools
- > SWIM

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#### Capabilities

- Combine advanced Flight Management System (FMS) with automation system to manage the position, altitude and timing of aircraft tracks so as to improve the stability, predictability and efficiency of the ATM system.
- The RTA function of FMS is employed to achieve STA so as to reduce controller intervention.





## **Functional Improvement for ATM Automation System**

Based on the ATC automation system, new functional modules are superimposed to support TBO operation.

#### Open interfaces

- Data link interfaces
- 4029.3
- Active MQ
- Customized IP interfaces

#### Auxiliary control

- 4D trajectory optimization
- Flight route optimization
- Digitalized control
- Control command execution monitoring

#### System capabilities

- Surveillance
- Alert
- Interval management
- HMI

# Increased function modules

- Data link processing
- RTA
- AMAN

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# **Prototype System**

### A TBO-capable automation system

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Information sharing via IP network and third-party simulator / airborne FMS system



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# **RTA Processing Mechanism of ATM Automation System**



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# **Increased Functionalities of ATM Automation System**

- > G-A coordination
- 4D prediction
  trajectory and EPP
- > RTA

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- Using EPP information improves the position accuracy and predicted position accuracy of the track for ground system;
- Enhance the precise execution of regulatory commands;
- High-precision position sensing improves conflict detection and safety management and reduces controller workload;
- Improve the accuracy of ETA in AMAN functions and promote the pre-planning and deployment of airport resources;

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# **Future trends of TBO-based ATM Automation System**

- Transition from voice control to digitalized control
- Performance monitoring
- Conflict detection and avoidance in advance
- Maximum utilization of flow management and airspace



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# Thank you for your attention!

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