CETC LES Info

NUMEN3000 ATC Automation System and its Applications

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CETC LES INFORMATION SYSTEM CO. , LTD

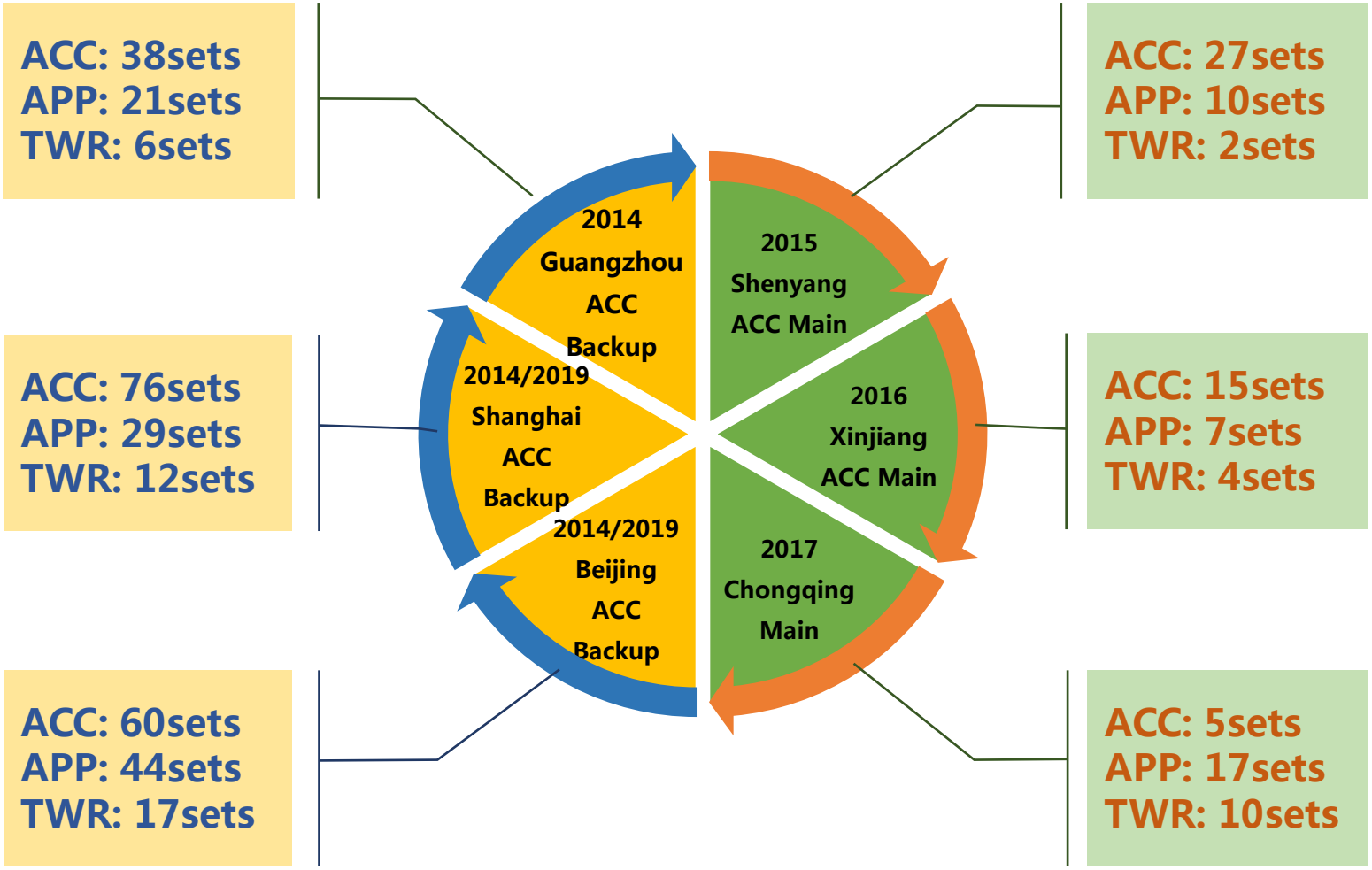
Contents

Concept(ATCAS)

- Receives and processes radar and other surveillance data in real time to provide controllers with air situation display, flight conflicts and various abnormal warning information;
- Provides controllers with flight plans and navigation dynamic information through associated flight plans and surveillance data.
- **A comprehensive management system that assists controllers in implementing air command, providing air traffic control services, and ensuring the safety of aircraft gate-to-gate operations.**

Project Experience

NUMEN3000 Applications



System Scale

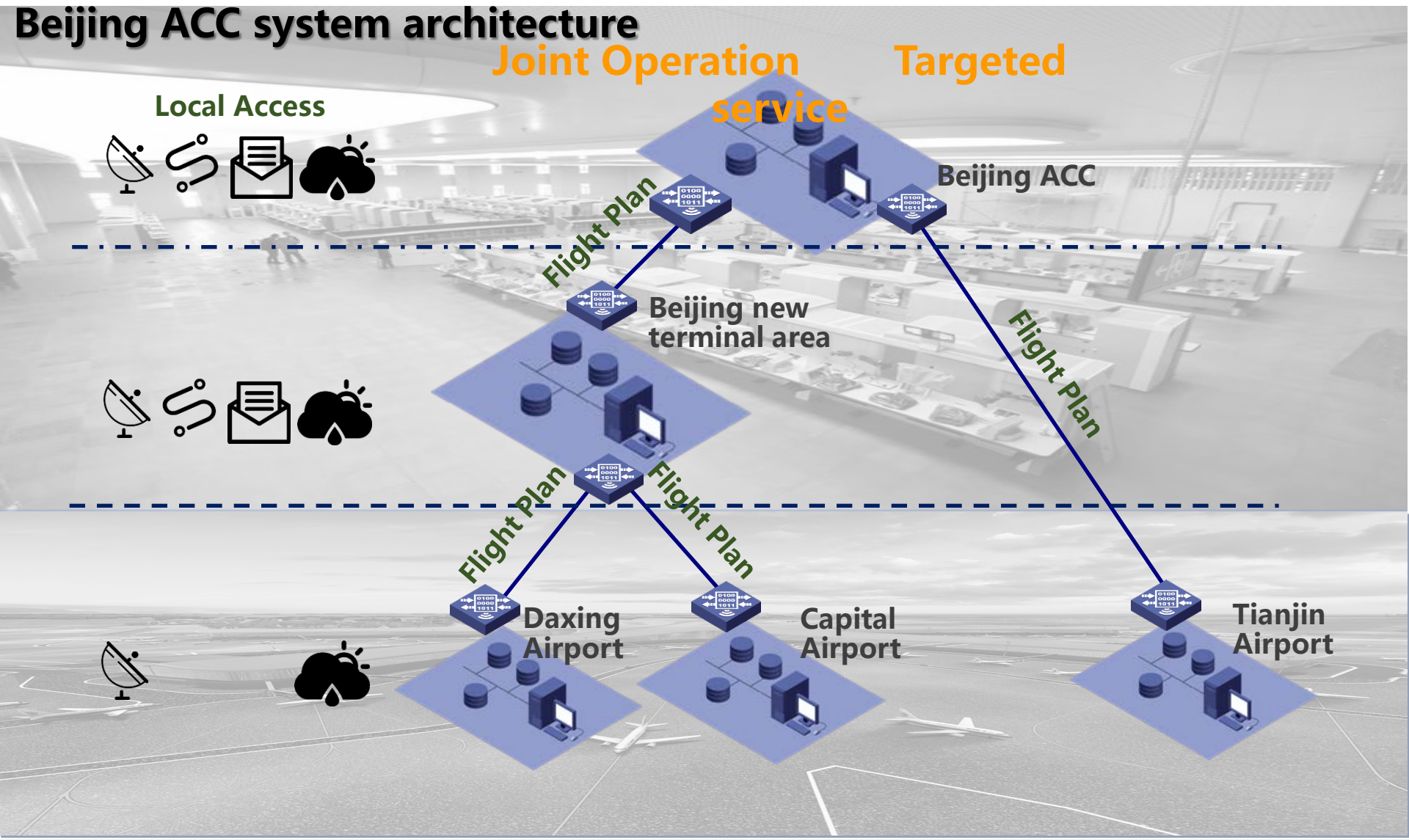
Node Evaluation of Beijing ACC System

The automation backup system for Beijing ACC, TMA and Tianjin TMA is currently the largest ATC system in the world.

Types	Server/ Position amount	Server/Position node amount	Remark
Beijing ACC	109	174	including 23 new positions
Beijing New TMA	85	127	All positions configured
Beijing Capital Airport	17	17	All positions configured
Beijing Daxing Airport	23	23	All positions configured
Tianjin Airport	27	39	All positions configured
Beijing Shadow TMA	40	61	All positions configured (shadow mode)
All	301	443	
Total	total node amount : 443		Including node amount of TMA (shadow mode)

System Architecture

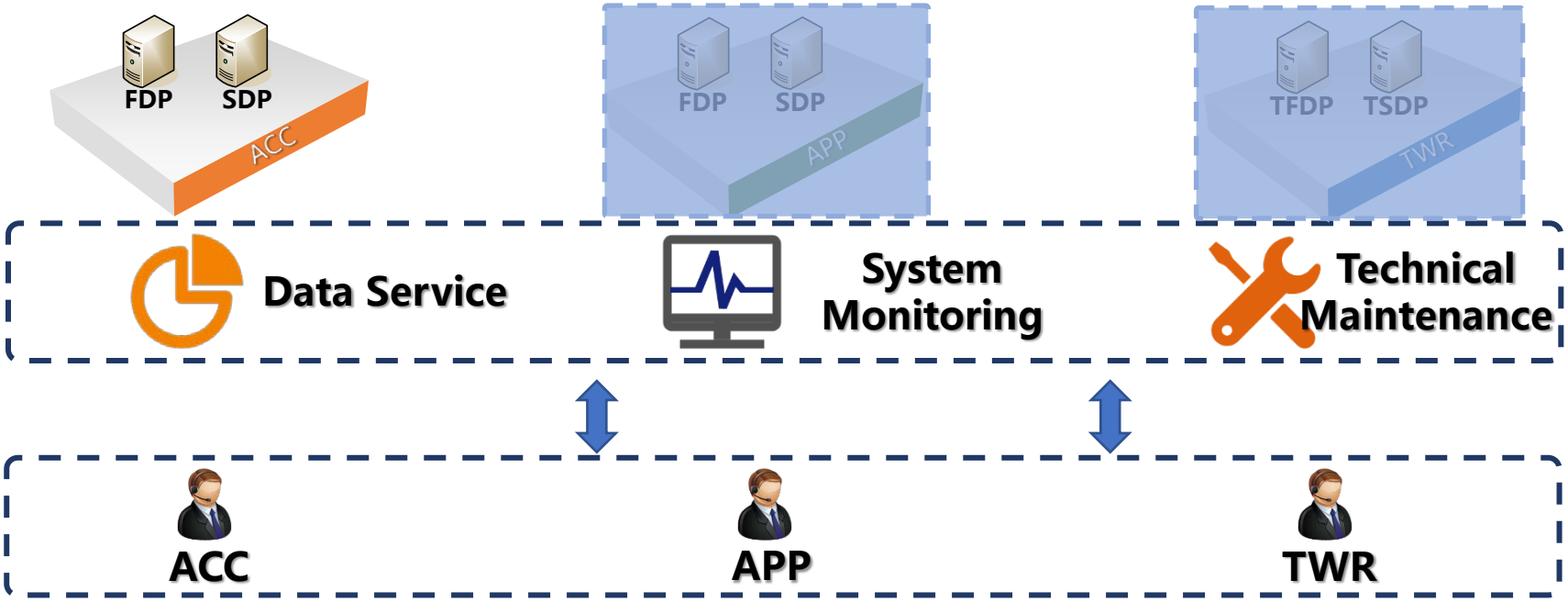
Beijing ACC system architecture



System Services

Full-Lifecyle Services

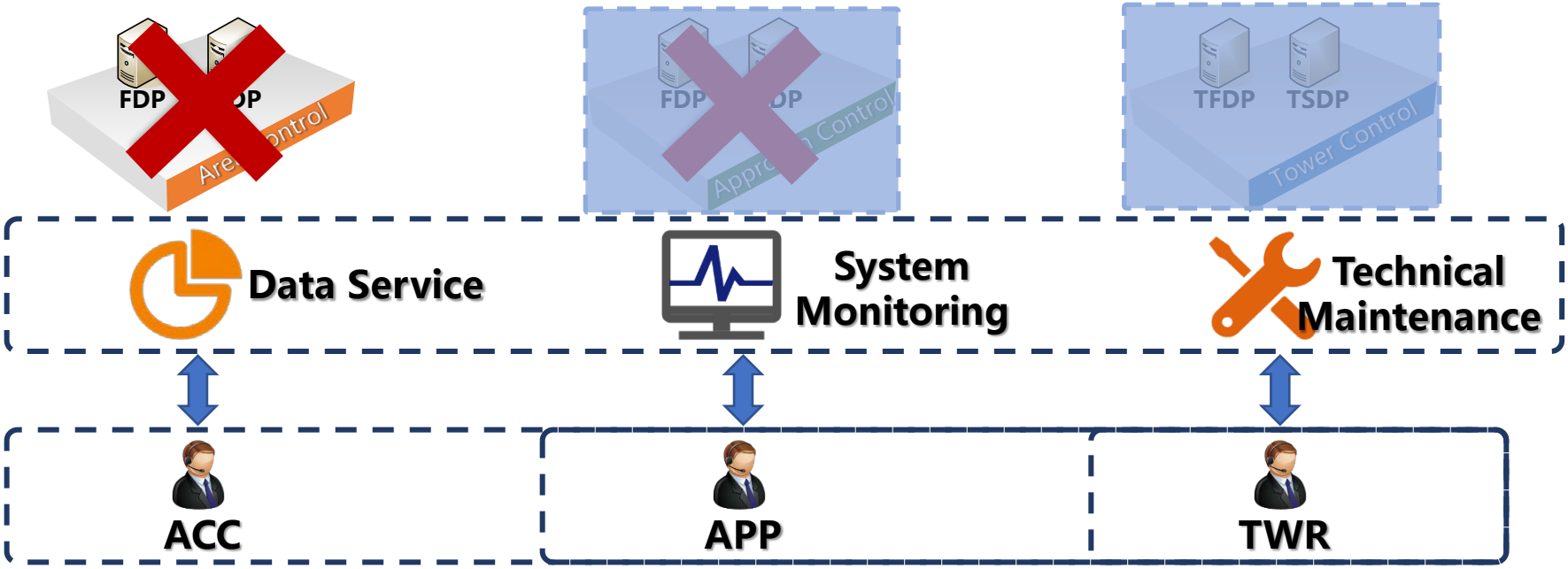
- A functional framework for the scope of control, authority and information category.
- Able to realize the top-down integrated control services and reduce control coordination.



System Service Type

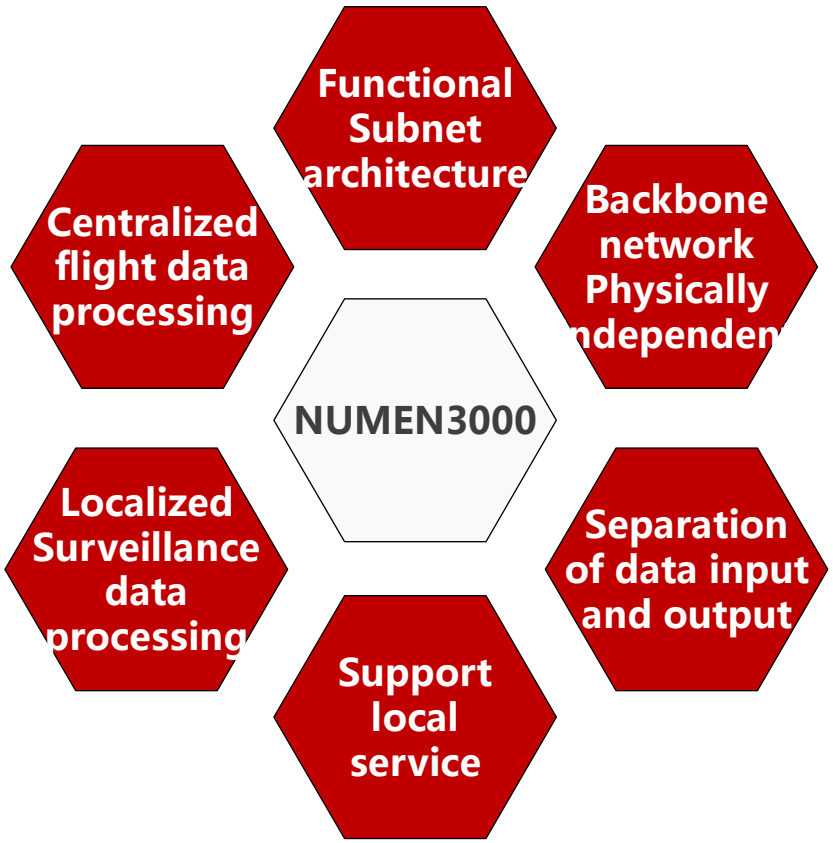
Micro Service

- APP partition can independently support the APP service and TWR service.
- Remote tower being equipped with independent data service subsystem.



System Enhancement

System Structure Features



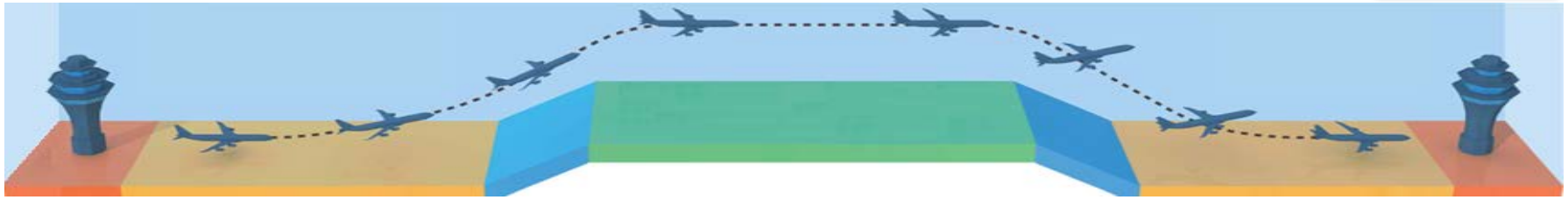
- Separated operational data network, monitoring network, data replay network
- Redundant operational network to ensure quality of service
- Separated access and output data processing equipment to avoid interference
- Partitions of control services
- Monitoring local data, independent operation
- Centralization of flight data and integration processing

System Highlights

System Structure Features

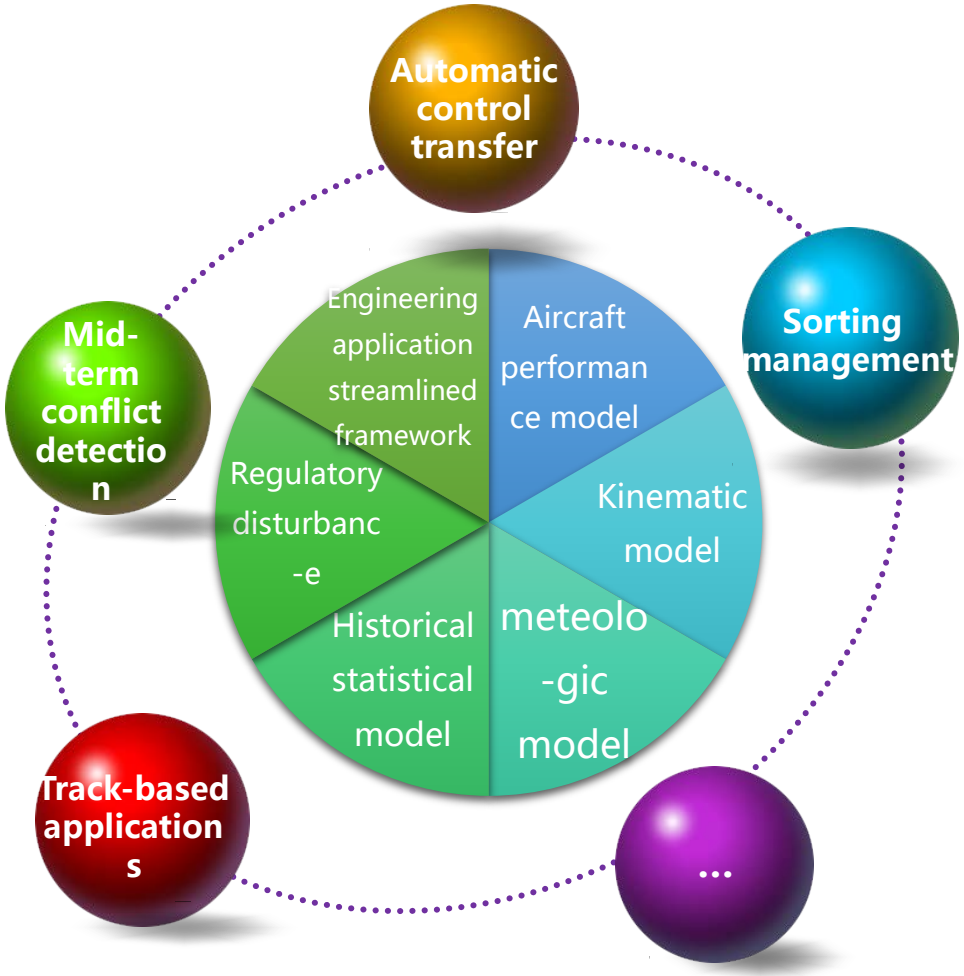
Beijing Area Control
NUMEN-3000 ATC system

- Quality-based surveilla-nce data fusion
- AMAN based on time slot allocatio n
- Flexible handover
- Enhanced real-time track prediction
- Security-based consiste-ncy monitor-ing
- Efficient control operatio n and informat -ion display
- Upgrade and downgrade manageme-nt based on partitional service

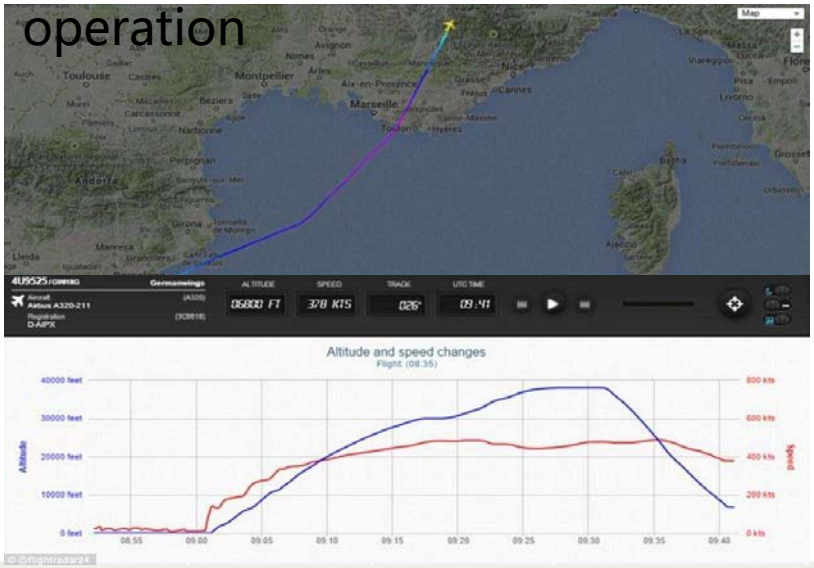


System Features

Enhanced real-time track prediction



- Being committed to the mid/short-term conflict prediction of control services
- Enhancing the intervention of historical track and control hand-over points on trajectory prediction
- Configuring hybrid prediction model + credibility model
- Supporting performance/trajectory-based operation



System Features

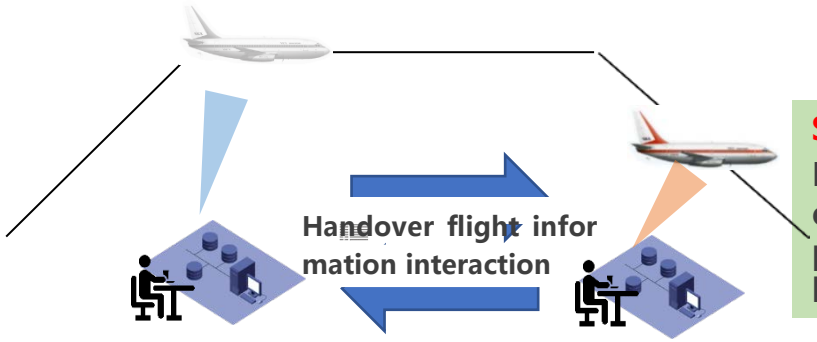
Flight Hand-Over

- OLDI – Eurocontrol Data Exchange Standard
- AIDC – ICAO Data Exchange Standard for Air Traffic Control Units in the Asia-Pacific Region
- FAA NAS Standards – U.S. regulatory unit transfer standard
- MH/T 4029.3 type C message – China regulatory transfer standard
- In the future, under the framework of ASBU, FO and FIXM supporting FF-ICE and SWIM will appear.

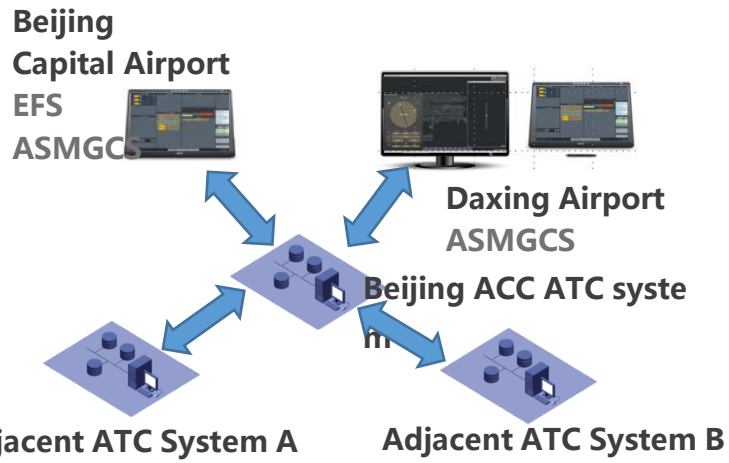
Based on MH/T 4029.3, it realizes flight data exchange, enabling the tower and approach controller to synchronize data and operations.

The data includes:

- ◆Basic flight plan data
- ◆Hand-over flight data
- ◆Gate information
- ◆Runway status
- ◆Arrival and departure procedures



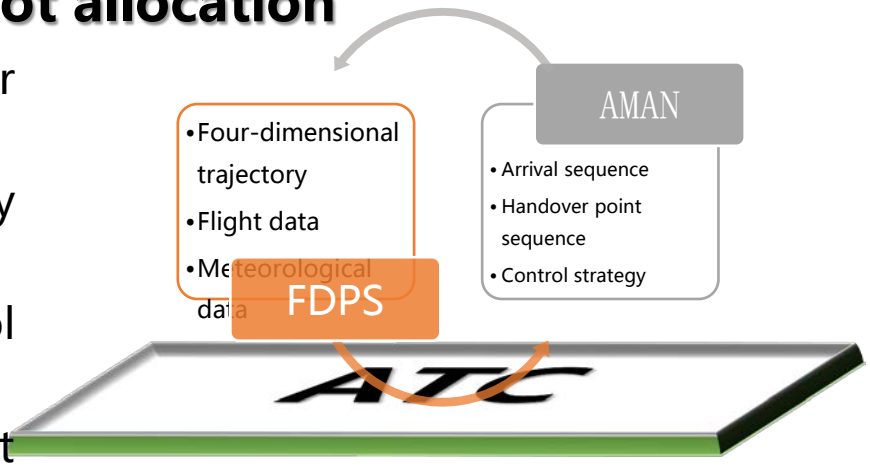
Solved : Limitations of fixed point handover

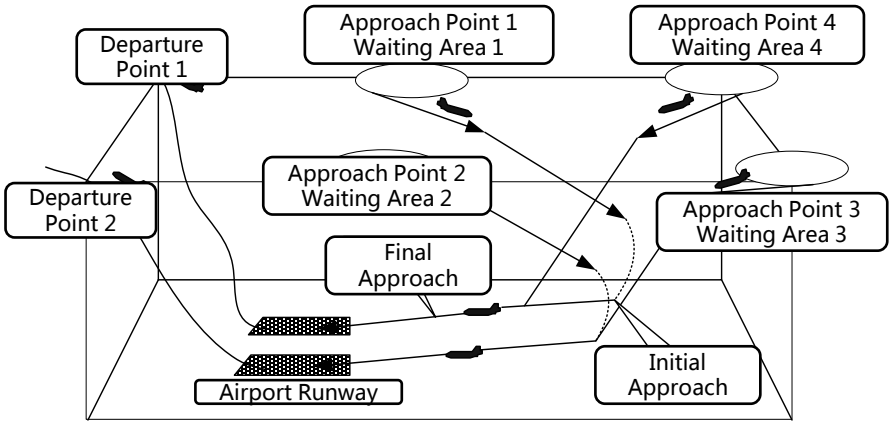


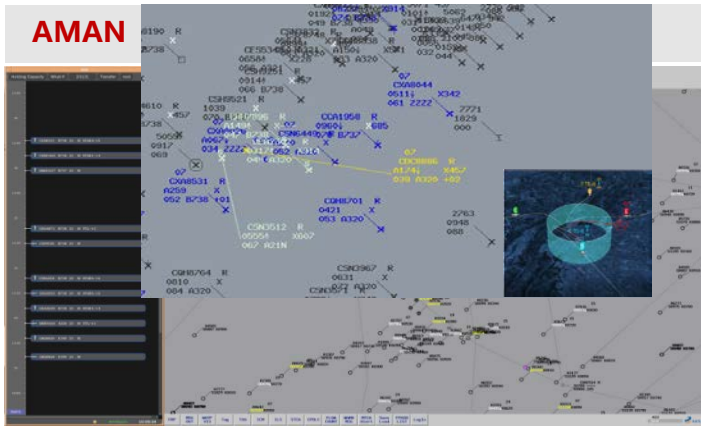
System Features

Arrival management based on time slot allocation

- Independent decision-making support for arrival flight sequence management
- Time slot management based on 4D trajectory prediction technology
- Support TBO technology, APP/TMA control decision support
- Control function and decision support information sharing, support interoperability mode



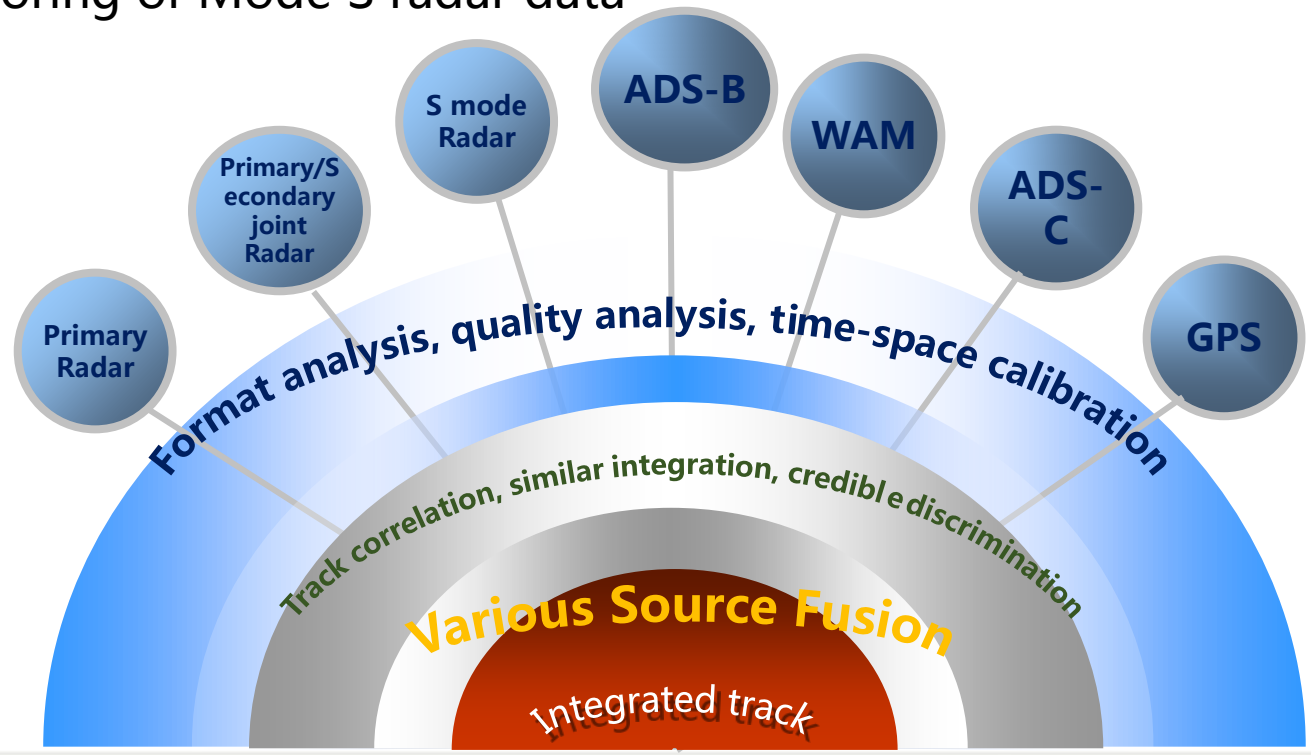




System Features

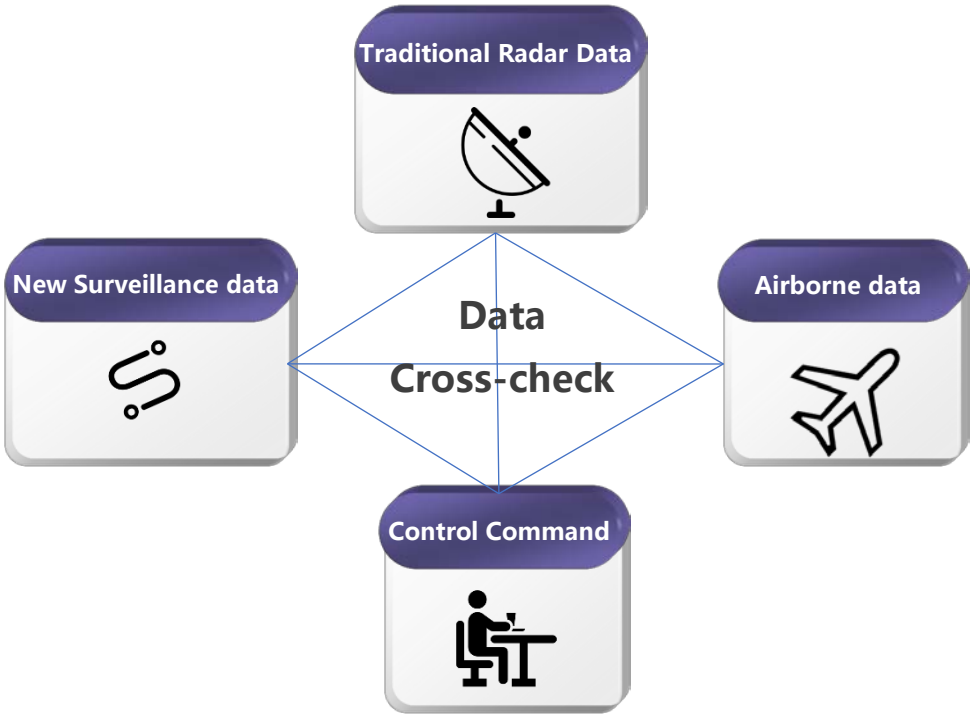
Quality-based surveillance data fusion

- Distributed, multi-channel based, phased data fusion
- Pre-configuration of surveillance source parameters, self-learning adjustment of parameters and reliability
- Correction and monitoring of Mode S radar data
- ADS data reference



System Features

Security-based consistency monitoring

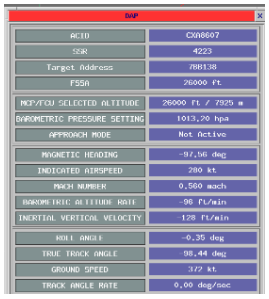


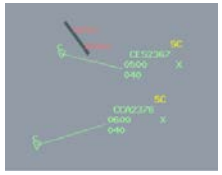
Information Analysis

- SSR Code consistency comparison
- Location point comparison
- CFL consistency monitoring
- Aircraft Trend Monitoring
- Route consistency monitoring
- Command Execution monitoring
- ……

Airborne Downlink Control Confirmation Data = ? Control operation data

Provide difference display of window information, labels and tracks

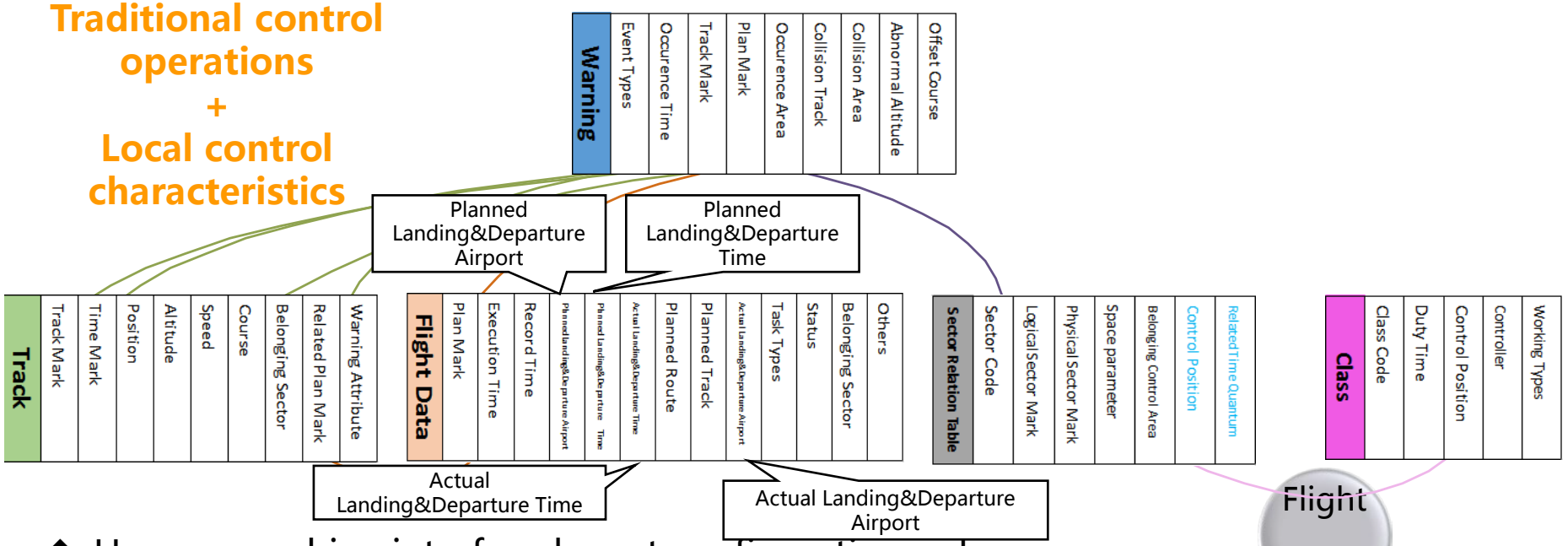




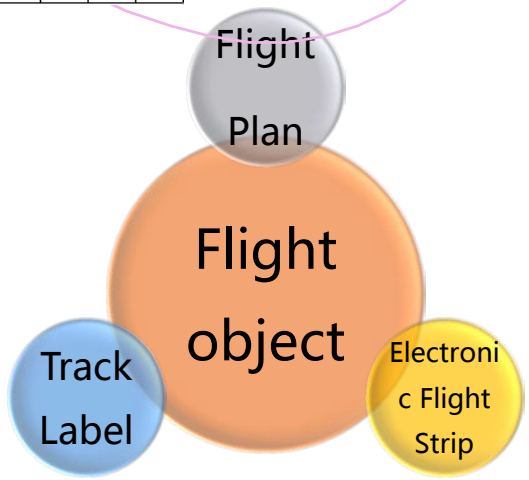
System Features

Efficient control operation and information display

Traditional control operations + Local control characteristics



- Human-machine interface layout configuration, role configuration
- Information Association Display Based on Knowledge Graph
- Multi-entry function operation
- Usability of information and warnings
- Error Message Display

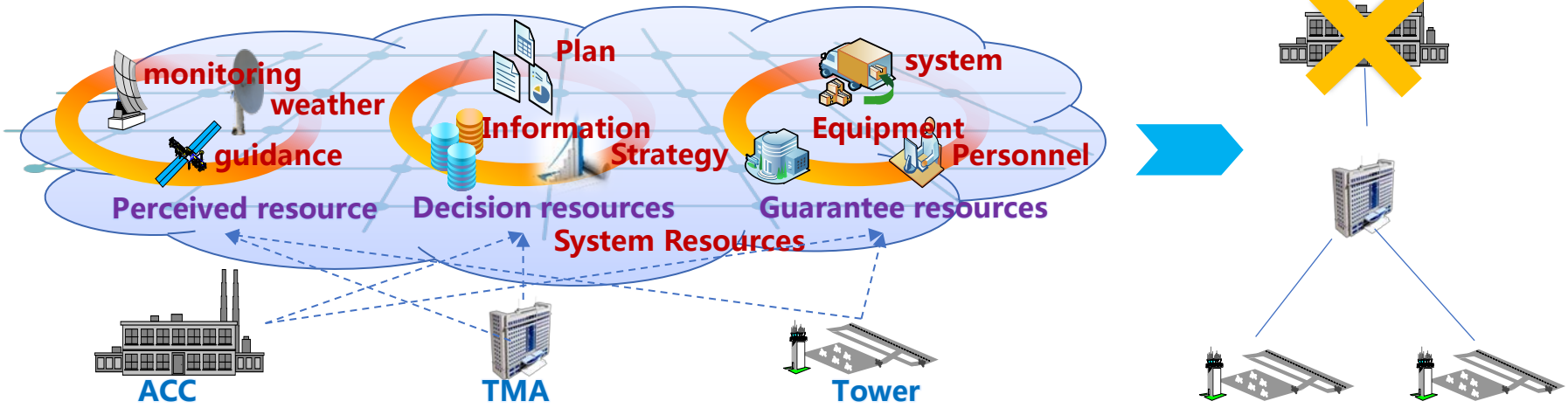


System Features

Upgrade and downgrade management based on block service

The ACC and TMA are equipped with entire services. The system has a unified service mechanism for ACC flight plan processing (default configuration). When the network or ACC flight data processing fails between subsystems, the terminal area system will support independent operation and implements service degradation.

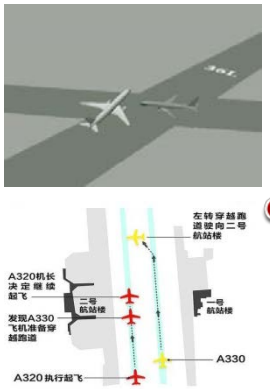
Under the three layer architecture of ACC, APP, TWR systems, it provides block monitoring services for each partition, covering equipment, network, software and so on, track logs, fault detection, and troubleshooting suggestions.



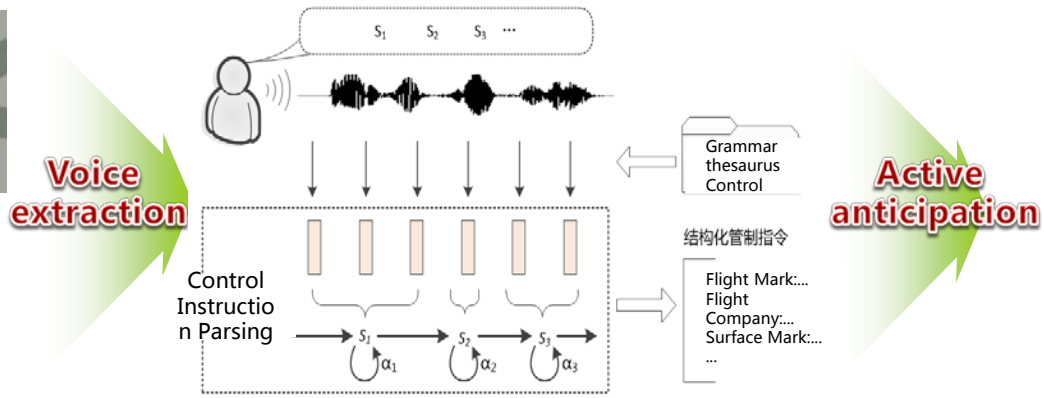
Contents

Voice-based operational safety monitoring

The Voice Recognition Technology based on deep learning , it integrates the controller’ s voice into ATC system to avoid the "error, forgetting, and omission" of the controller, enhance the aviation safety monitoring ability and reduce the burden of the controller.



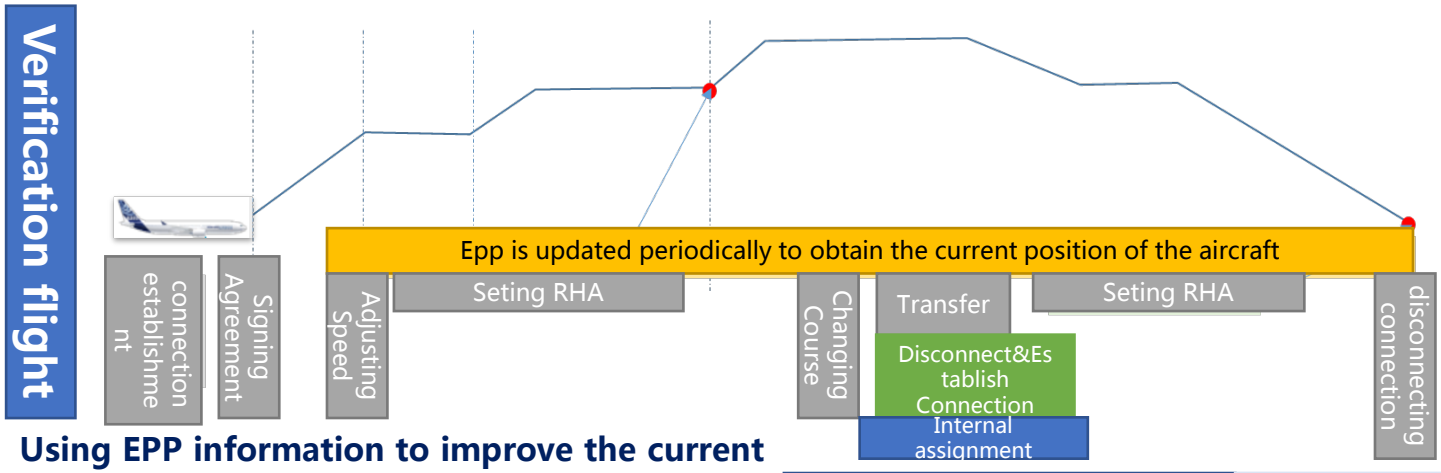
Runway incursion



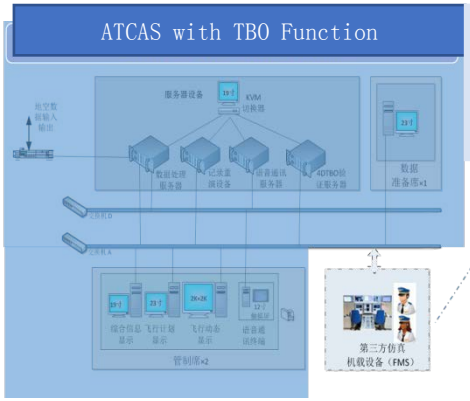
Voice recognition technology based on deep learning

- Control instructions are automatically integrated into the system
- Inconsistent control instructions
- Pilot retelling is inconsistent with control instructions
- Control instructions are inconsistent with the actual flight operation

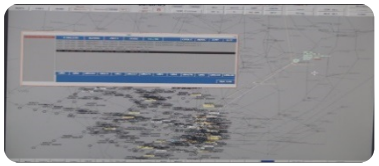
Application improvement based on TBO



- **Using EPP information to improve the current position accuracy and predicted position accuracy of the track in the ground system;**
- **Enhancing the precise execution of control instructions;**
- **High-precision location perception improving the conflict perception ability and the effect of safety management, and reduces the controller's workload;**
- **Improved accuracy of ETA in the AMAN function to promote the pre-planning and deployment of airport resources**



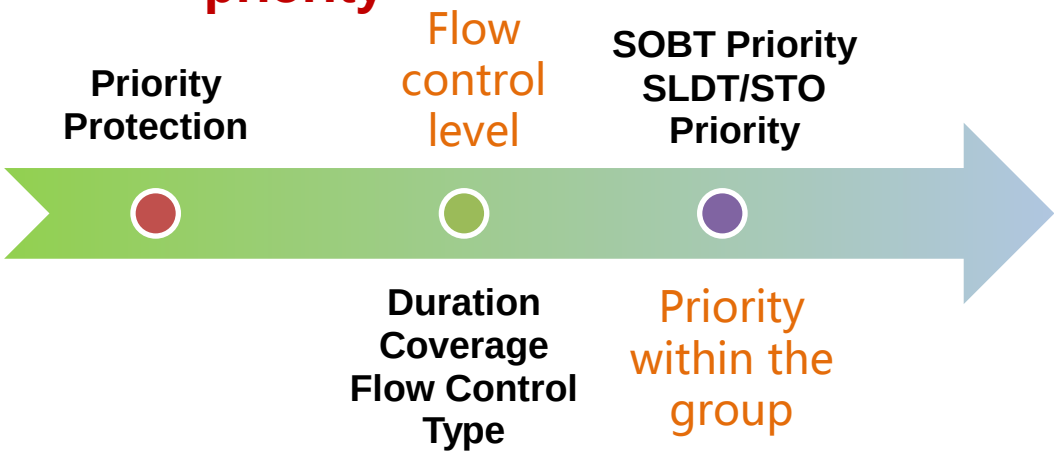
information interconnected by IP network and the third-party simulation airborne FMS system



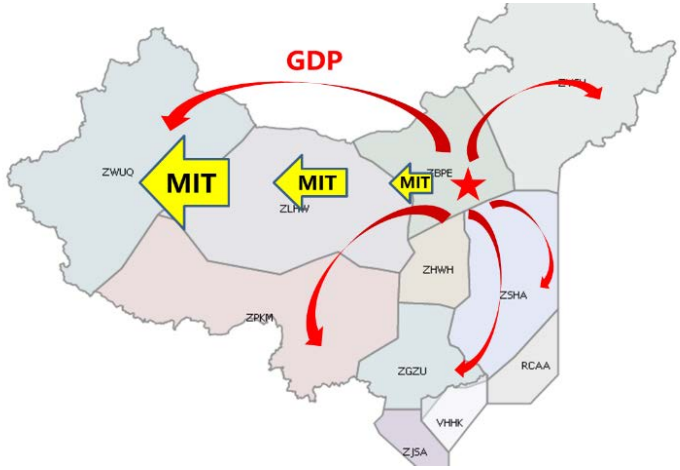
Integration of Collaborative Decision Making System

Aiming at the joint operation of multiple airports in the area, it provides the "event trigger + timing" calculation mode, proposes the concept of multi-dimensional priority order of flights, and designs the time slot allocation mechanism, which blocks the mutual disturbance between flow control measures and enhance the time slot stability.

✓ **Flight multi-dimensional priority**



✓ **Regional Processing**
✓ **Coordinated operation**

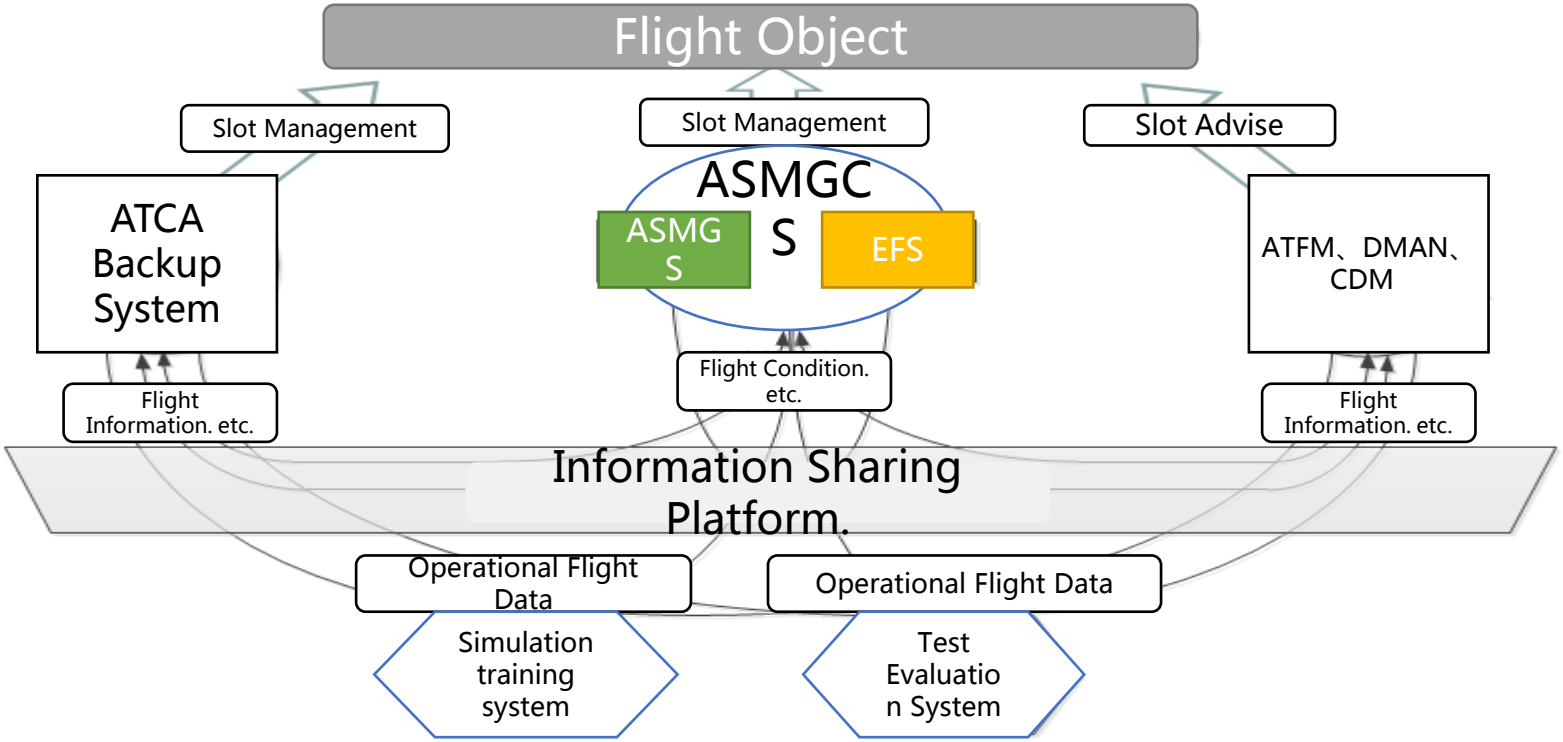


Information Sharing Based On Flight Objects

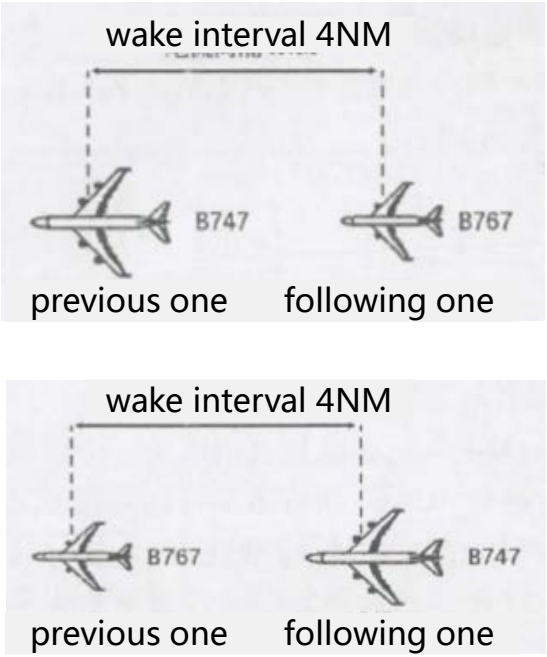
Break the data isolation, link relational and non-relational data

Form a data relationship graph

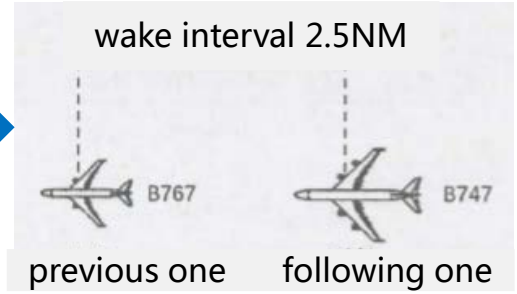
Establish linked data access



RECAT



Current Standard



RECAT

1.Data management function;

2.Flight data processing function;

3.Flight Message processing function;

4.Air situation information display function;

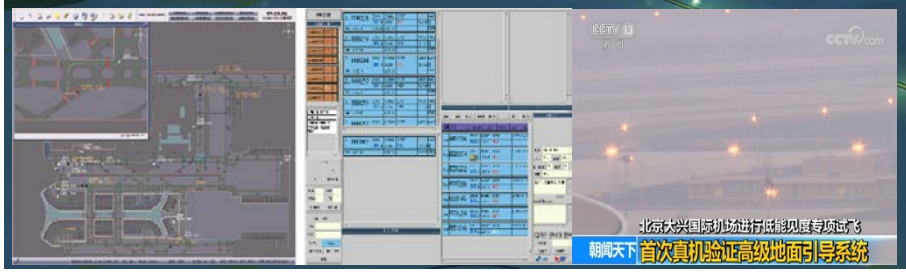
5.Wake interval warning and alert function.

Contents

ASMGCS system

ASMGCS systems are widely used in hubs and regional airports. They can detect aircraft and vehicles through surveillance sources such as field surveillance radars, and monitor, control, route planning and guidance of aircraft and vehicles on the surface of the airport. Assisting the controller to implement the integrated business system for the control of ground activity targets and ensuring the safe operation of aircraft to ensure the safe implementation of command tasks.

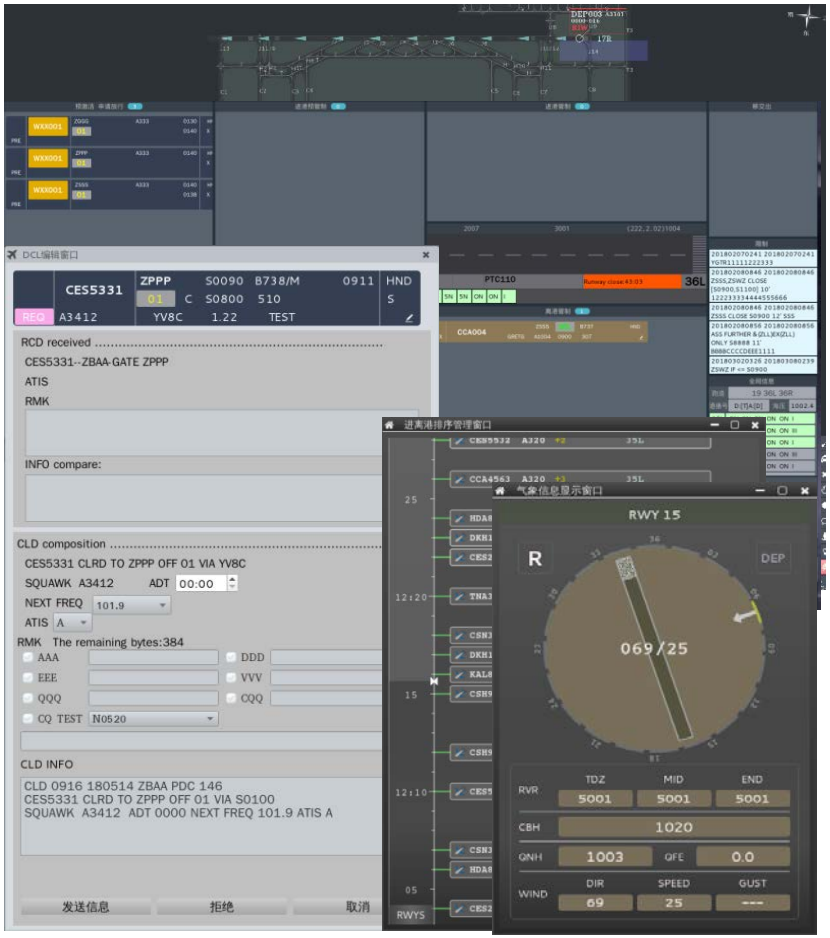
LES developed the A-SMGCS system for the Beijing Capital Airport and Daxing Airport has multiple functions such as surface monitoring, alarm control, routing planning, light guidance, etc., reaching the level IV operation standard recommended by ICAO, and can provide airport operation under low visibility safety assurance. It is truly an innovation and revolution in ground transportation management.



Surface management---I-TWR

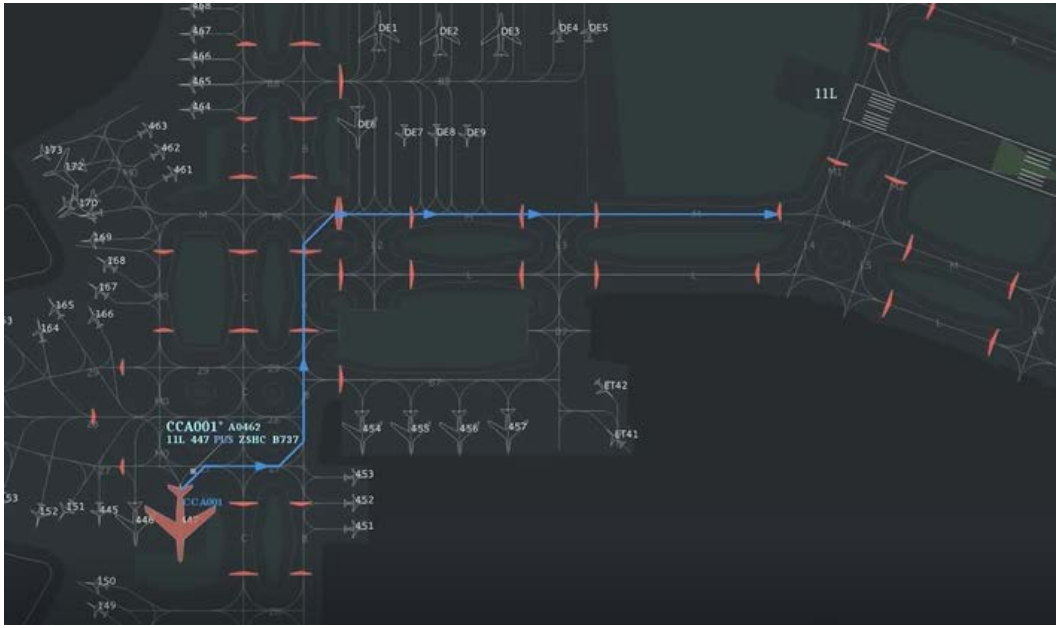
In view of the tower control process, innovate new models and new patterns, building an information integration framework based on the tower workflow, forming an integrated tower control system solution.

- **Integrated airport information, approach situation display and warning control;**
- **Advanced aircraft taxi routing planning and taxi guidance functions, reaching A-SMGCS IV level;**
- **Electronic Flight Strips function for paperless operation;**
- **Departure Clearance (DCL) function based on data link;**
- **Flexible display of comprehensive operating environment information (meteorological information, aeronautical information, flow control, etc.);**



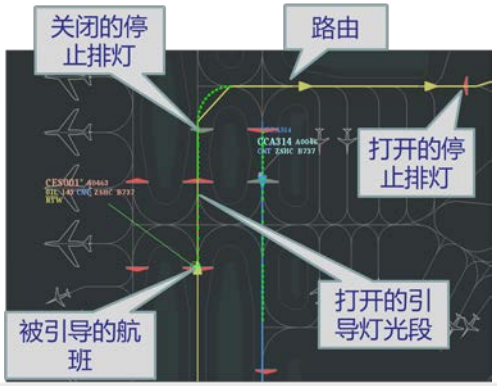
Automatic routing planning

Combined with the operating environment and flow distribution, the intelligent algorithms automatically provide optimized routes for arrival, departure, and towed flights based on the surface operating rules, allowing manual planning and adjustment.



Light Guidance

- Light Guidance
- Configurable light parameters



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