PMS Implementation in TMA Airspace

Air Traffic Management Bureau of CAAC

中国民用航空局空中交通管理局

ATMB

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CAAC

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空中交通管理局
Air Traffic Management Bureau.CAAC

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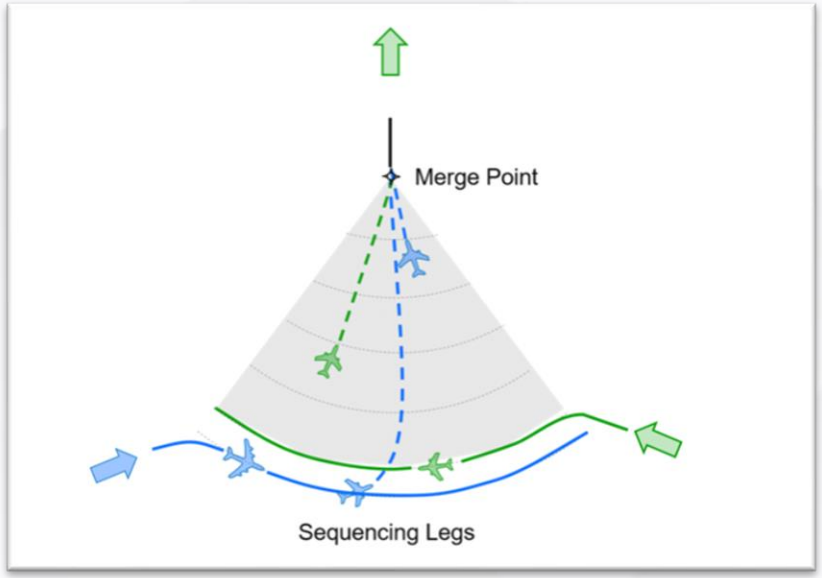
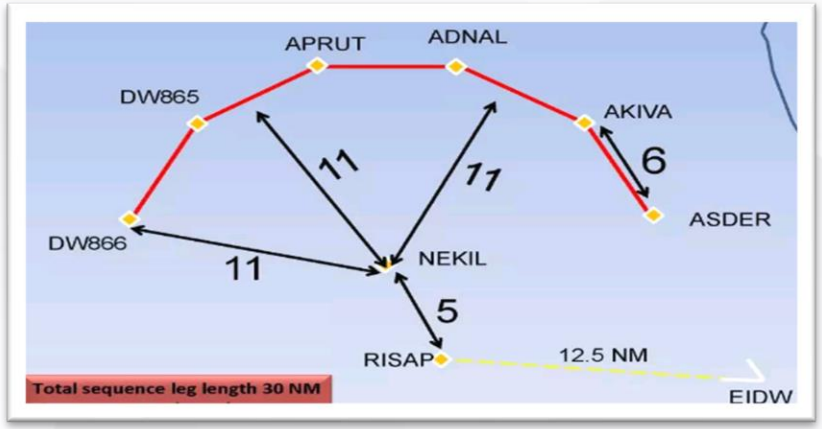
What is Point Merge System?

- **PMS** an integrated application of **PBN** technology for sequencing **arrival traffic**. The arrival track is extended or shortened by using the pre-designed principle of equal distance from the sequencing leg to a merge point, so as to realize the sequencing and spacing management of **multi-directional** arrival flow.



- **PMS** consists of **a merge point** and **two or more sequencing legs** equidistant (vertically separated) from the merge point.



The Development of PMS

With the economic development, the passenger flow and the number of flights increases rapidly.

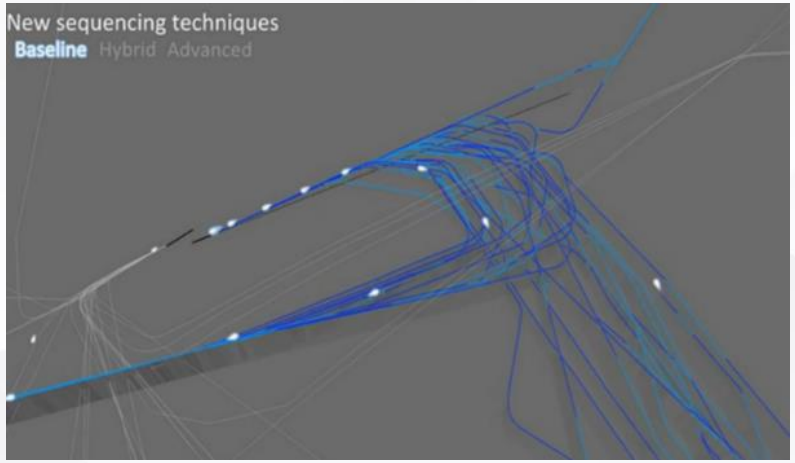
Frequent radar vectoring

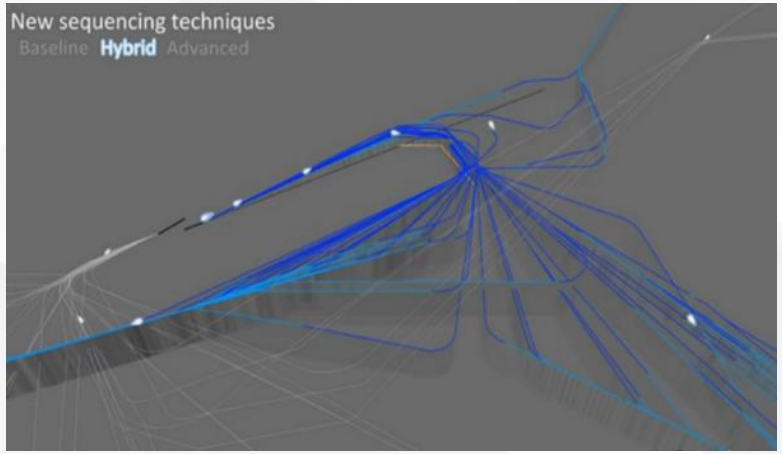
Difficulties in predicting and improving vertical profiles

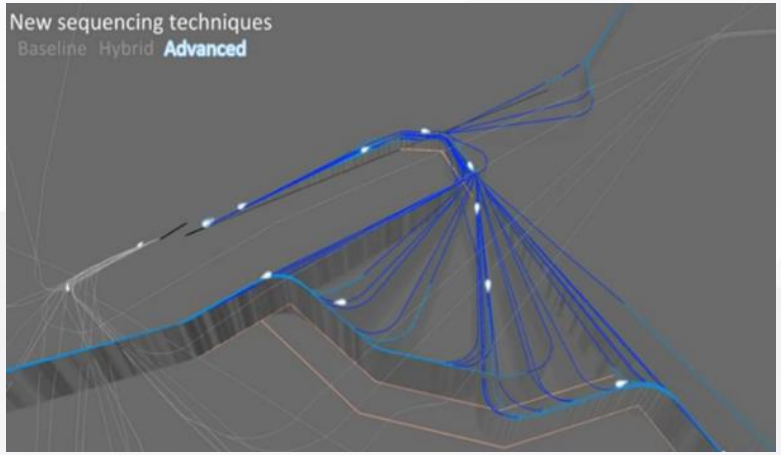
Large volume of air-ground communications

Poor situational awareness of pilot

The concept of PMS operation was proposed by EUROCONTROL in 2006







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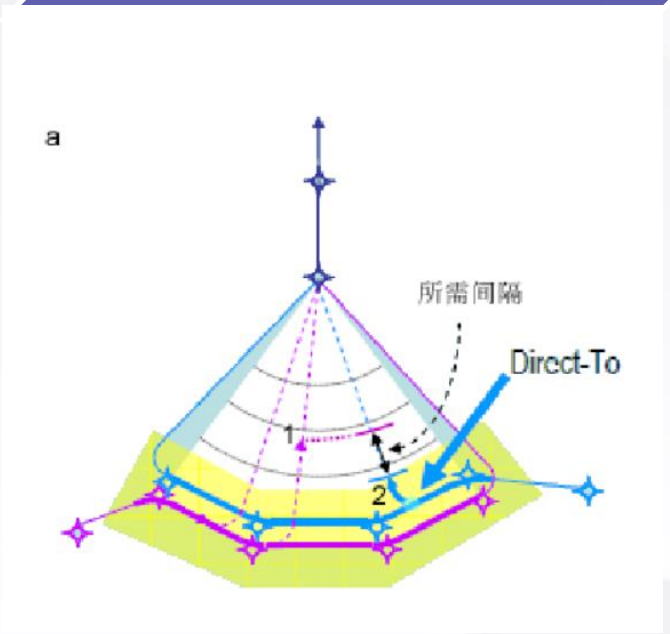
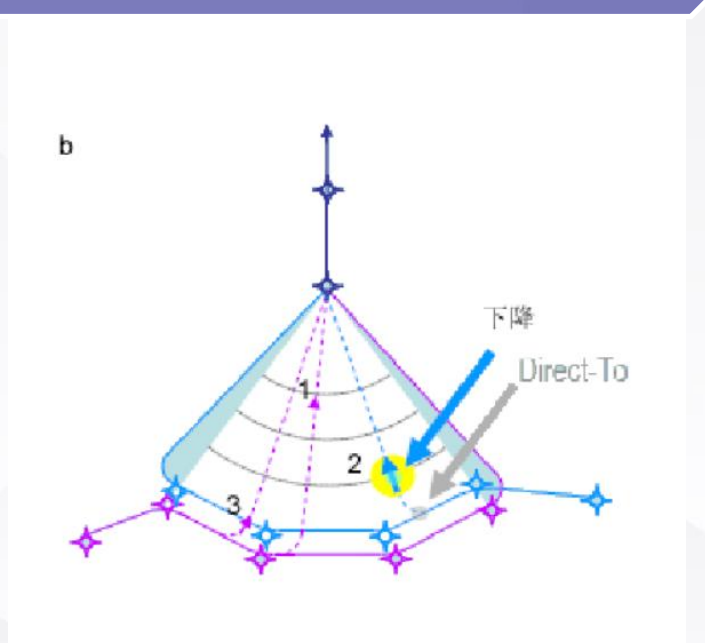
Operational procedures

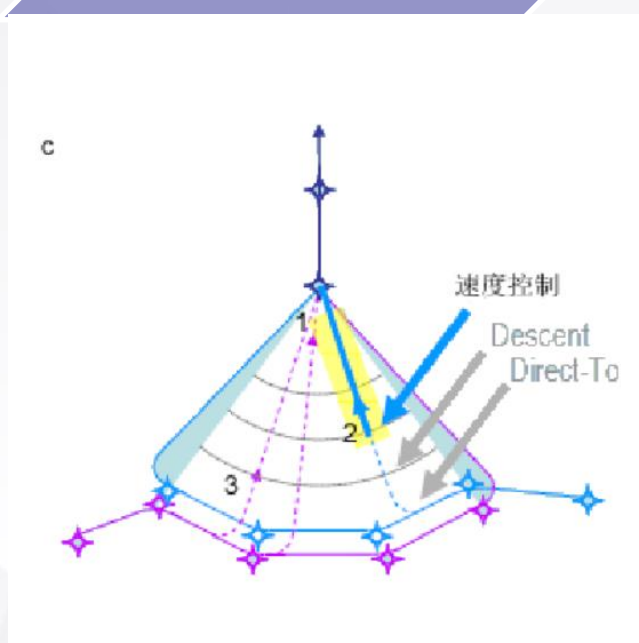
Enter sequencing arc and establish separation

Direct to MP and Maintain separation

Monitor passing the merge point







For PMS operation, there is usually only one “direct to” instruction, and the separation is established by the timing of instruction.

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ICAO Recommendations

ICAO GANP PORTAL

ASBU ELEMENTS

RSEQ-B0/3

☑ Functional Description | ○ Enablers | ○ Deployment Applicability | ○ Performance Impact Assessment

RSEQ

RSEQ-B0/3	Point merge	Operational

☐ Sixth edition of the GANP

Main Purpose To allow merging of arrival flows.

New Capabilities Sequencing using pre-defined legs equidistant from a point that are used for shortening or stretching the arrival path.

Description This element represents a procedural concept that uses existing technology to merge arrival flows. Its purpose is to improve and harmonize arrival operations by enabling continuous descent operations (CDO) and increasing arrival predictability, thereby enhancing airport capacity and limiting the environmental impact of aircraft emissions. Point Merge is based on a specific route structure that is made of a point (the merge point) with pre-defined legs (the sequencing legs) equidistant from this point that are used for shortening or stretching the arrival path.

Maturity Level Ready for implementation

Human Factor Considerations

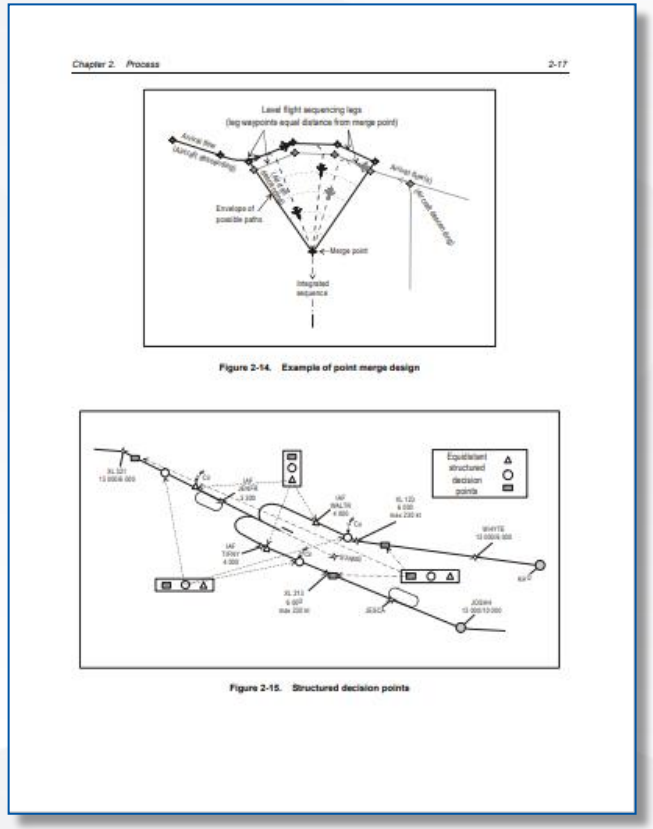
1. Does it imply a change in task by a user or affected others? Yes
2. Does it imply processing of new information by the user? No
3. Does it imply the use of new equipment? No
4. Does it imply a change to levels of automation? No

PLANNING LAYERS: Tactical-During ops

OPERATIONS: Arrival

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-operational benefit	WAKE-B2/1 - Wake turbulence separation minima based on 7 aircraft groups



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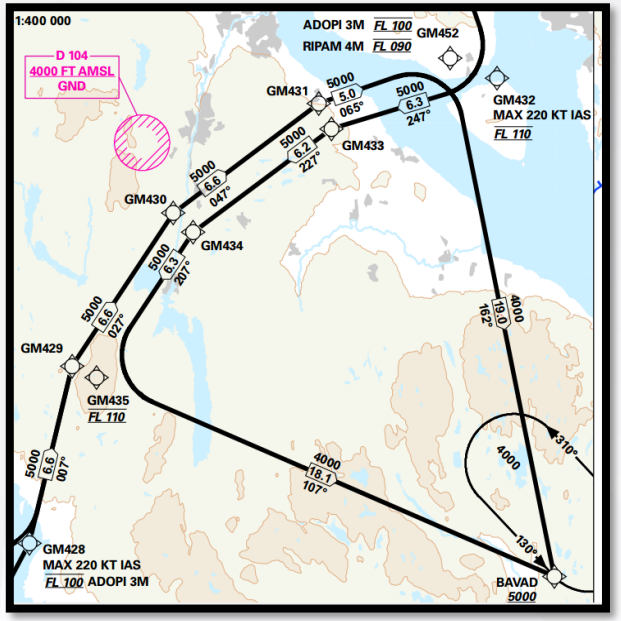
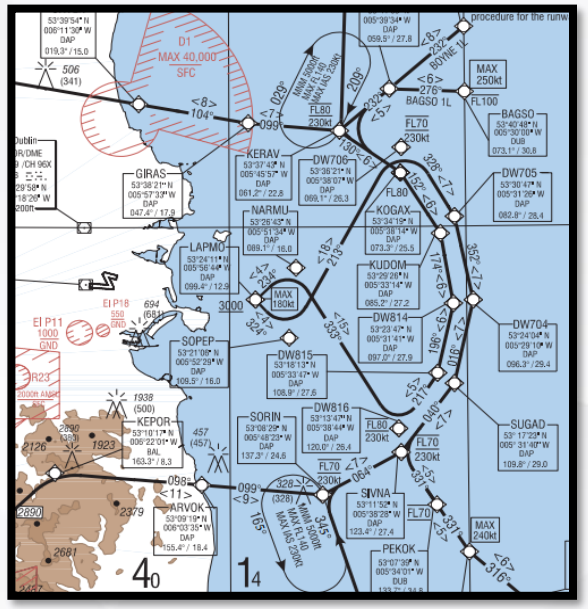
Global Implementation Status

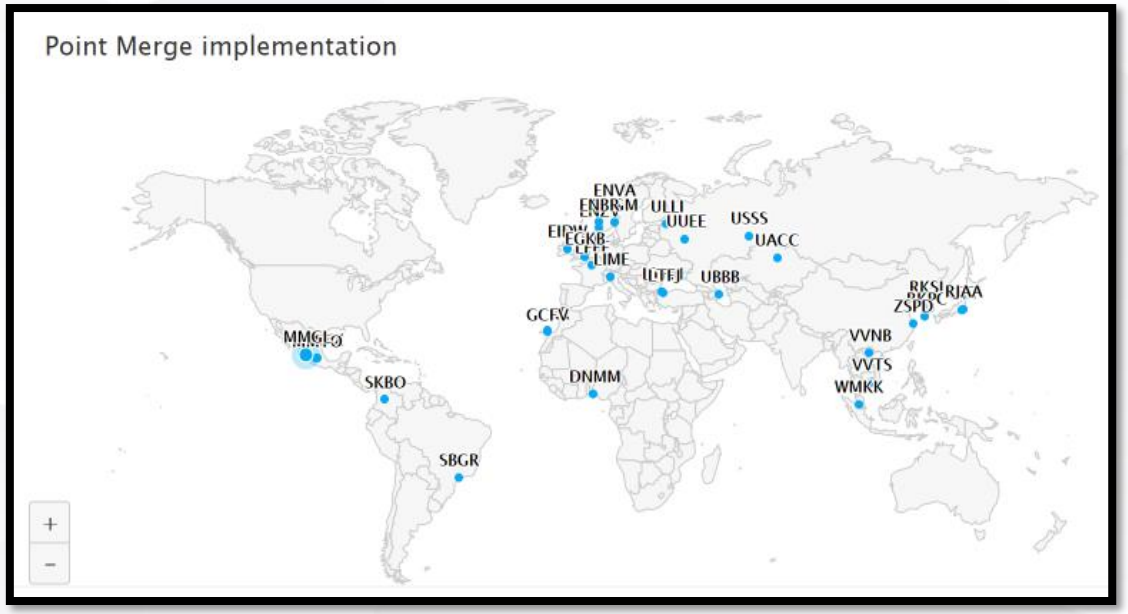
Started with Oslo (2011) and Dublin (2012), Point Merge is now operational for **38** airports through **19** countries and **4** continents.



2011 Oslo, Norway



2012 Dublin, Irish



38 airports with PMS operation globally

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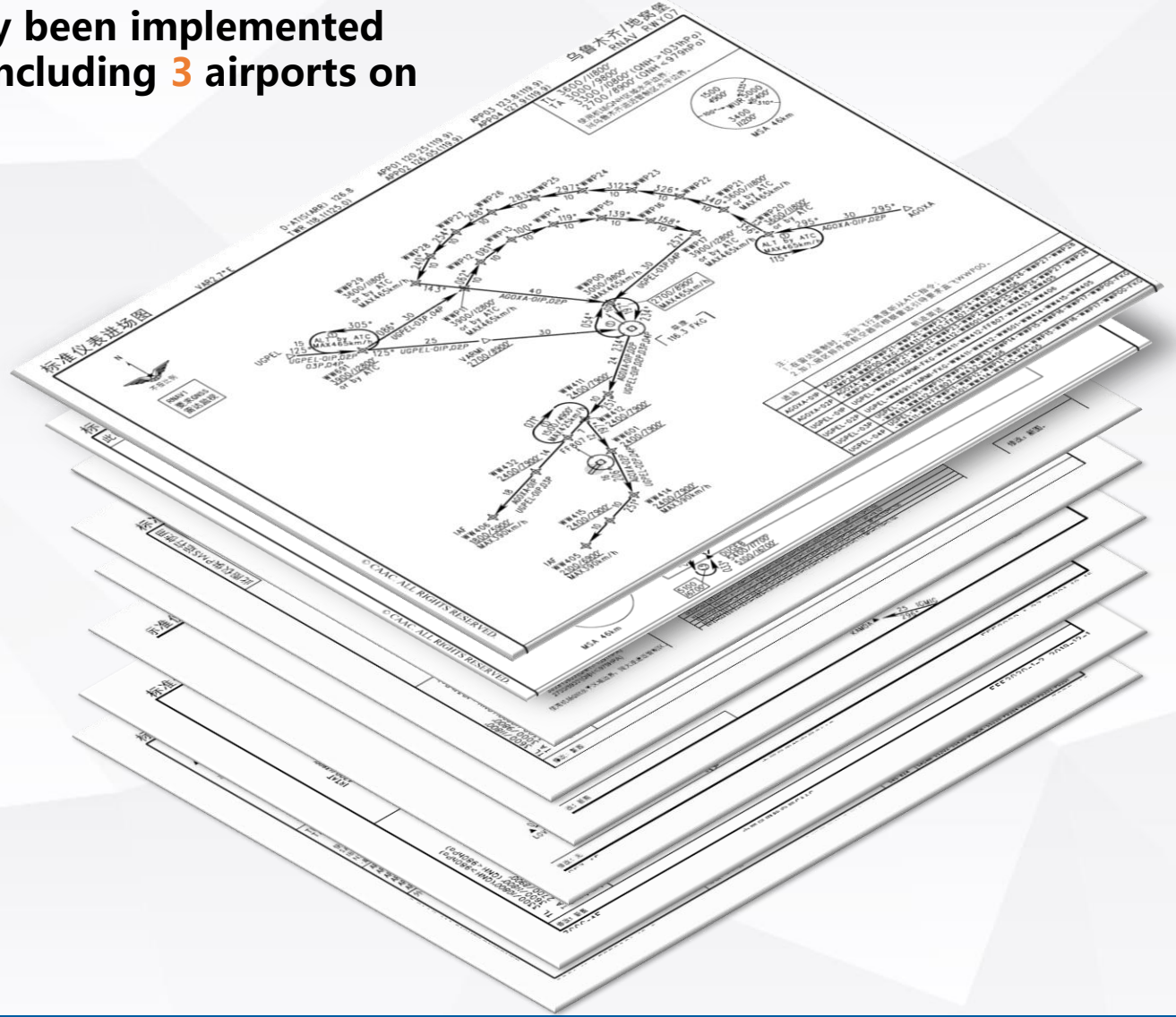
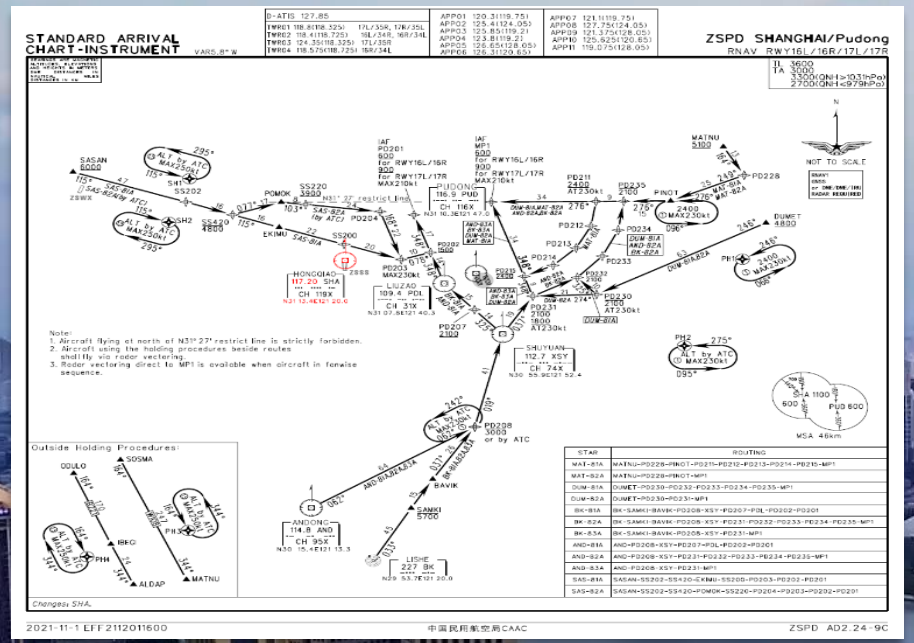
Current PMS Implementation Status

PMS has already been implemented in 11airports，including 3 airports on trail last year.

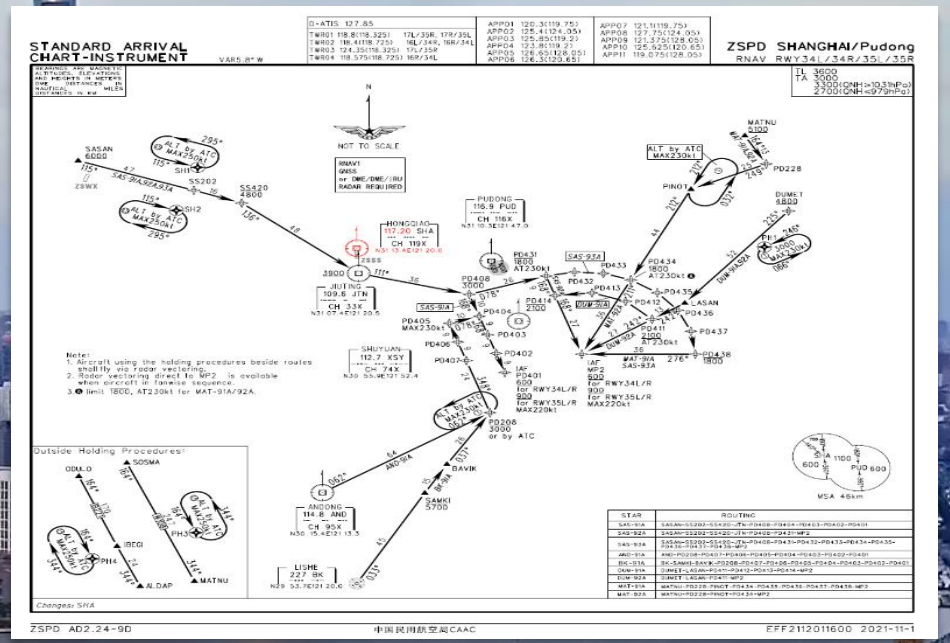


8. Urumqi Intl. Airport
7. Beijing Intl. Airport
6. Dalian Intl. Airport
5. Wuhan Intl. Airport
4. Zhengzhou Intl. Airport
3. Shenzhen Intl. Airport
2. Guangzhou Intl. Airport
1. Pudong Intl. airport

Shanghai Pudong Intl. Airport(ZSPD) PMS

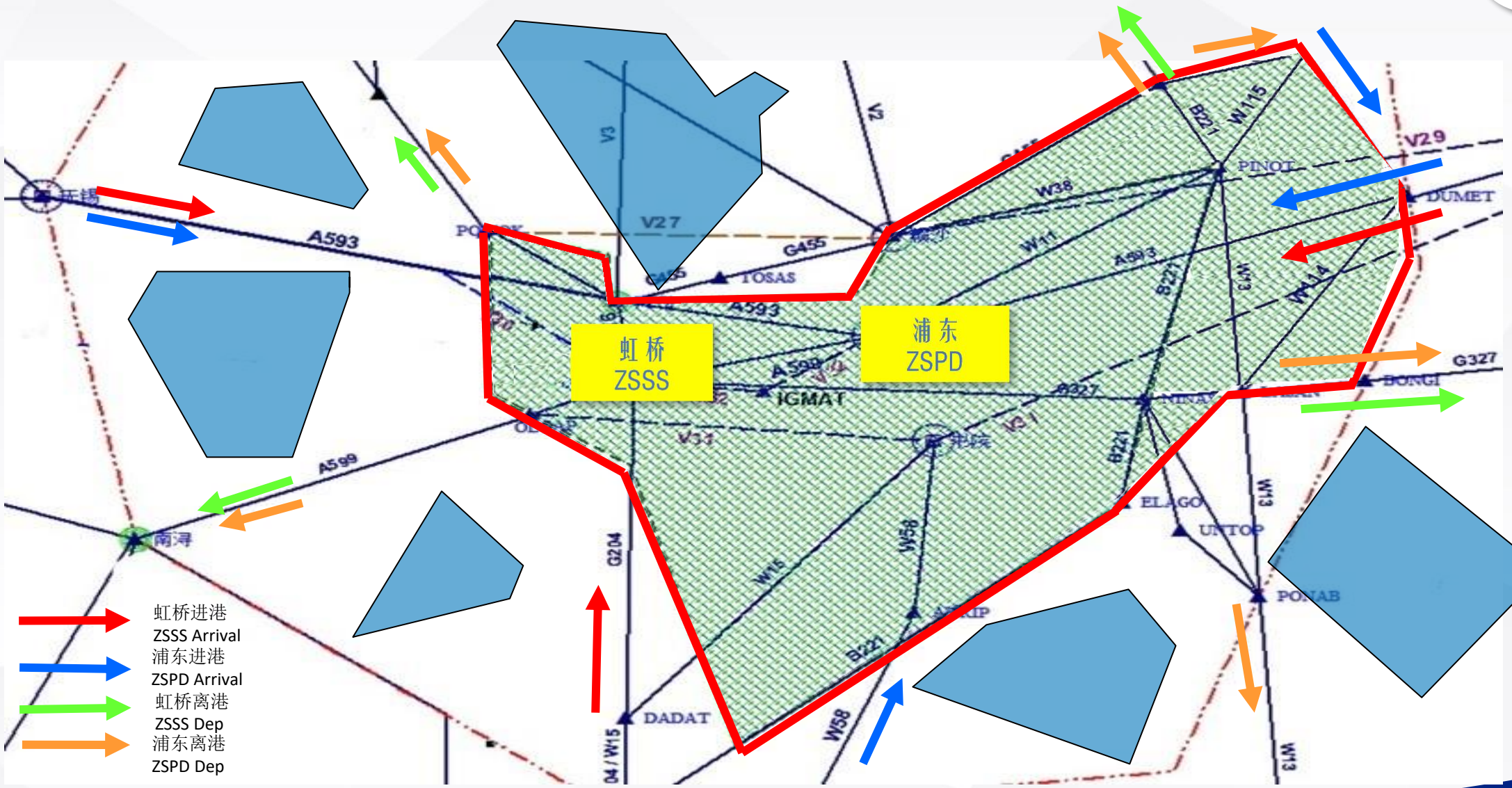


ZSPD (RWY 16L/R 17L/R) Officially implemented PMS operation in Dec. 2019



ZSPD (RWY 34L/R 35L/R) Officially implemented PMS operation in Dec. 2020

Radar Vectoring Airspace in Shanghai TMA



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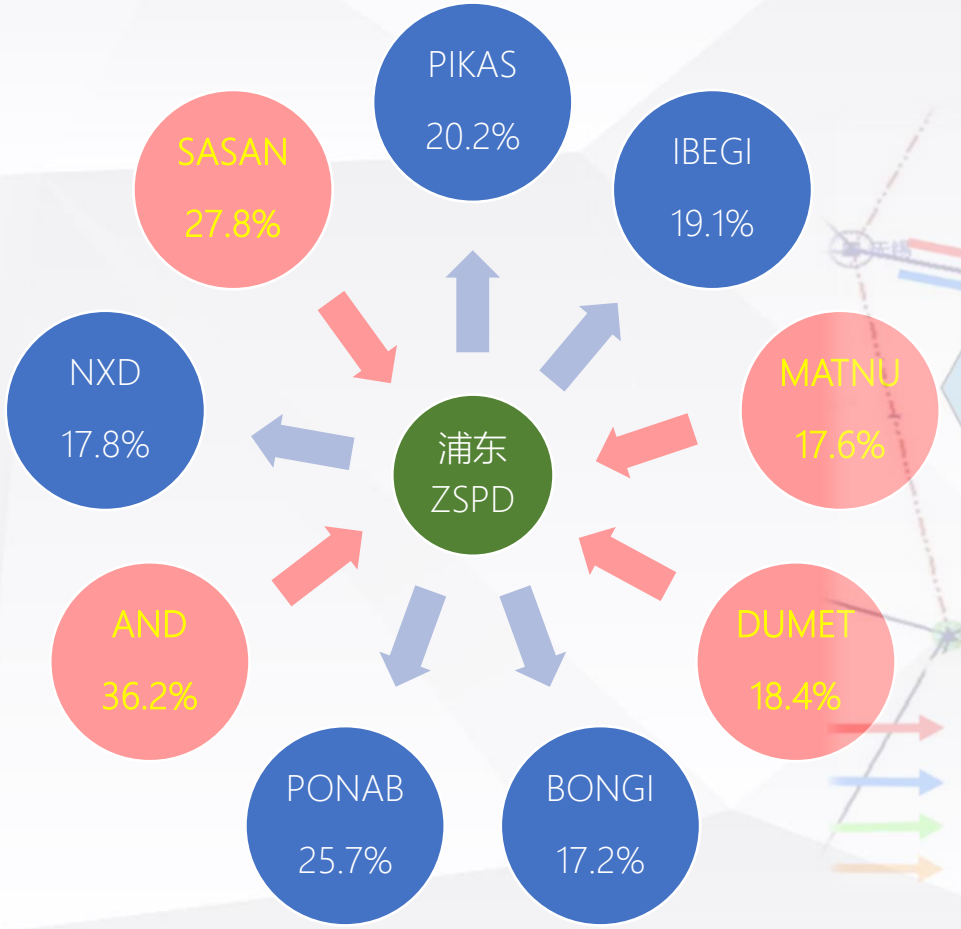
The Concept Design of PMS in Shanghai TMA



- Determine the position of PMS procedure according to the available airspace range.
- Based on the arrival flow characteristics of all directions and operational demand, the entry direction of PMS procedure is selected.

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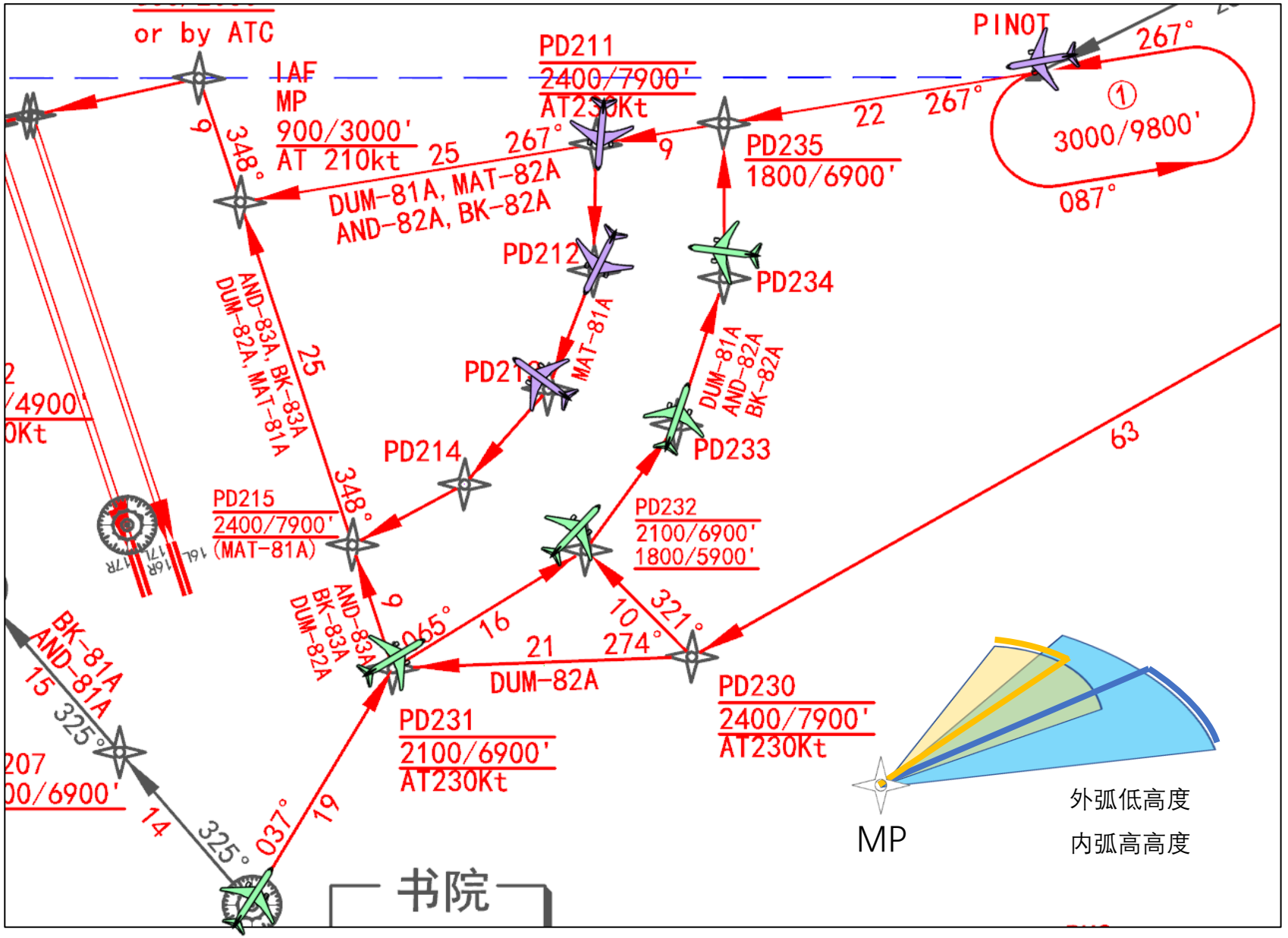
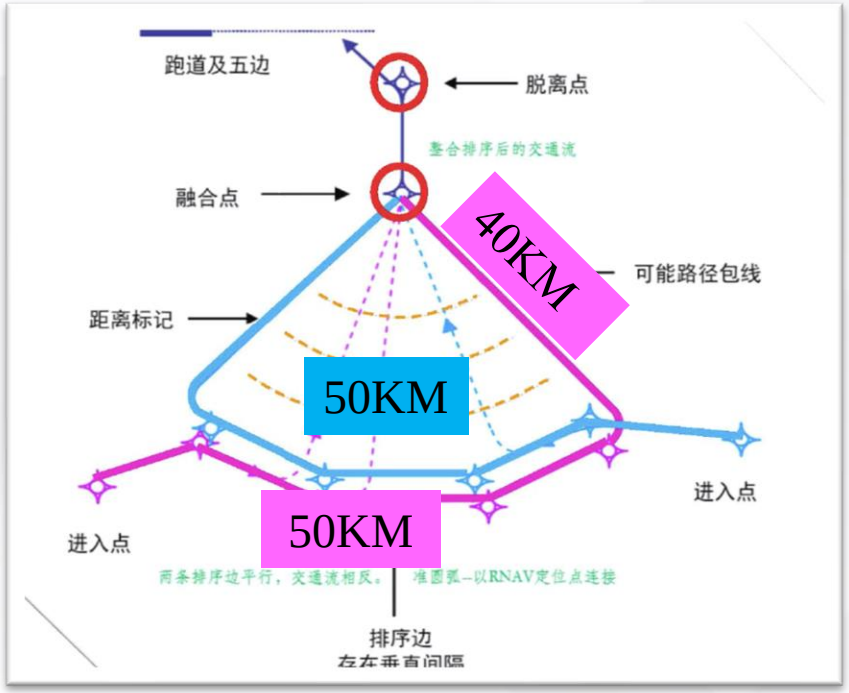
The Demo of PMS of Pudong Intl. Airport (Southward)

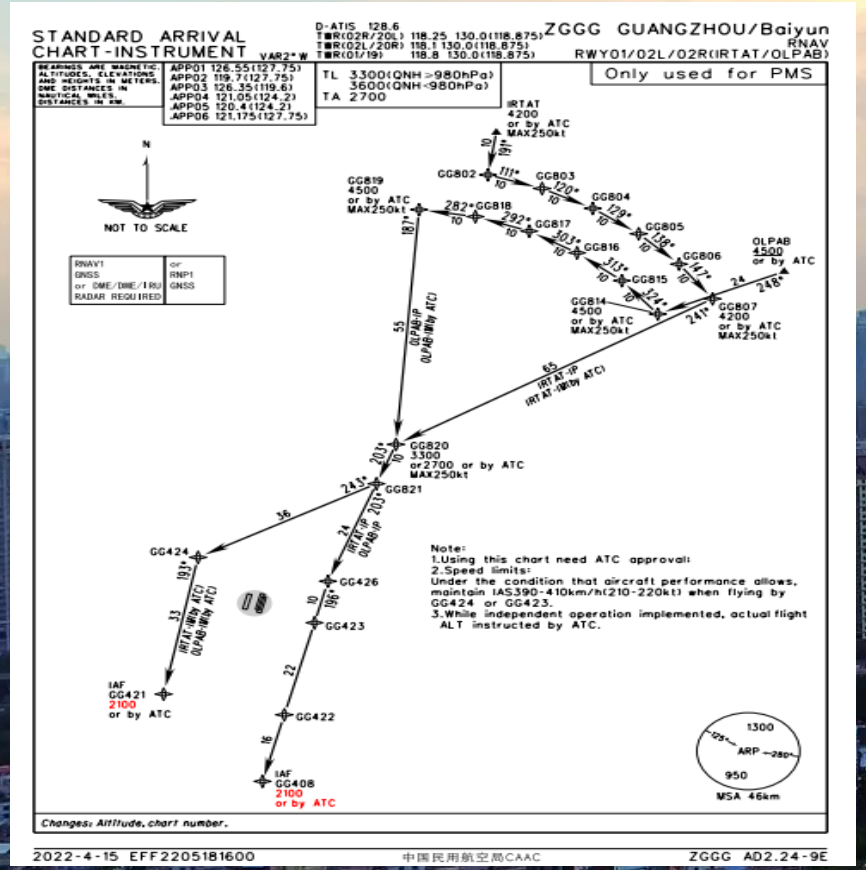


The Experience of PMS procedure Design in Shanghai TMA



- Equidistance from sequencing legs to merge point (usu. 40km);
- The length of each sequencing segments are 40-50km;
- The speed on the sequencing leg is normally 210-230kt;
- Inner leg designed higher (usu. 300m) than outer leg with appropriate distance e.g. 10km;
- The merge point is preferably deployed near the turning point of the final

Guangzhou Baiyun Intl. Airport(ZGGG) PMS



ZGGG(RWY 16L/R 17L/R) implemented PMS trail operation in Jan. 2020

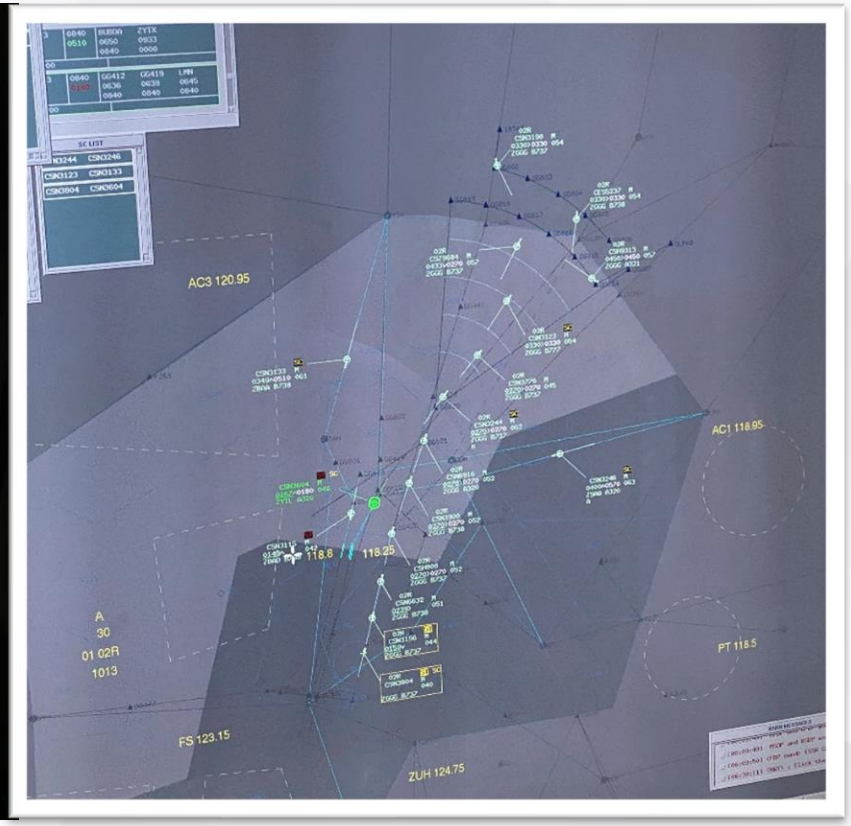
Trail Operation of PMS in Guangzhou

No.	Date (Jan.2020)	Executed sorties	Not executed sorties	Total sorties	Impli. rate
1	2nd	13	8	21	61.90%
2	4th	24	0	24	100.00%
3	5th	25	0	25	100.00%
4	6th	27	0	27	100.00%
5	.8th	20	3	23	86.96%
6	11th	23	0	23	100.00%
7	12th	21	1	22	95.45%
8	15th	23	2	25	92.00%
9	19th	24	1	25	96.00%

The trial operated smoothly, which verifies the application value of PMS procedure.

Trail Operation of PMS in Guangzhou APP

The view from the cockpit during the trial operation



Part 1

Part 1

Cockpit View

Radar Screen

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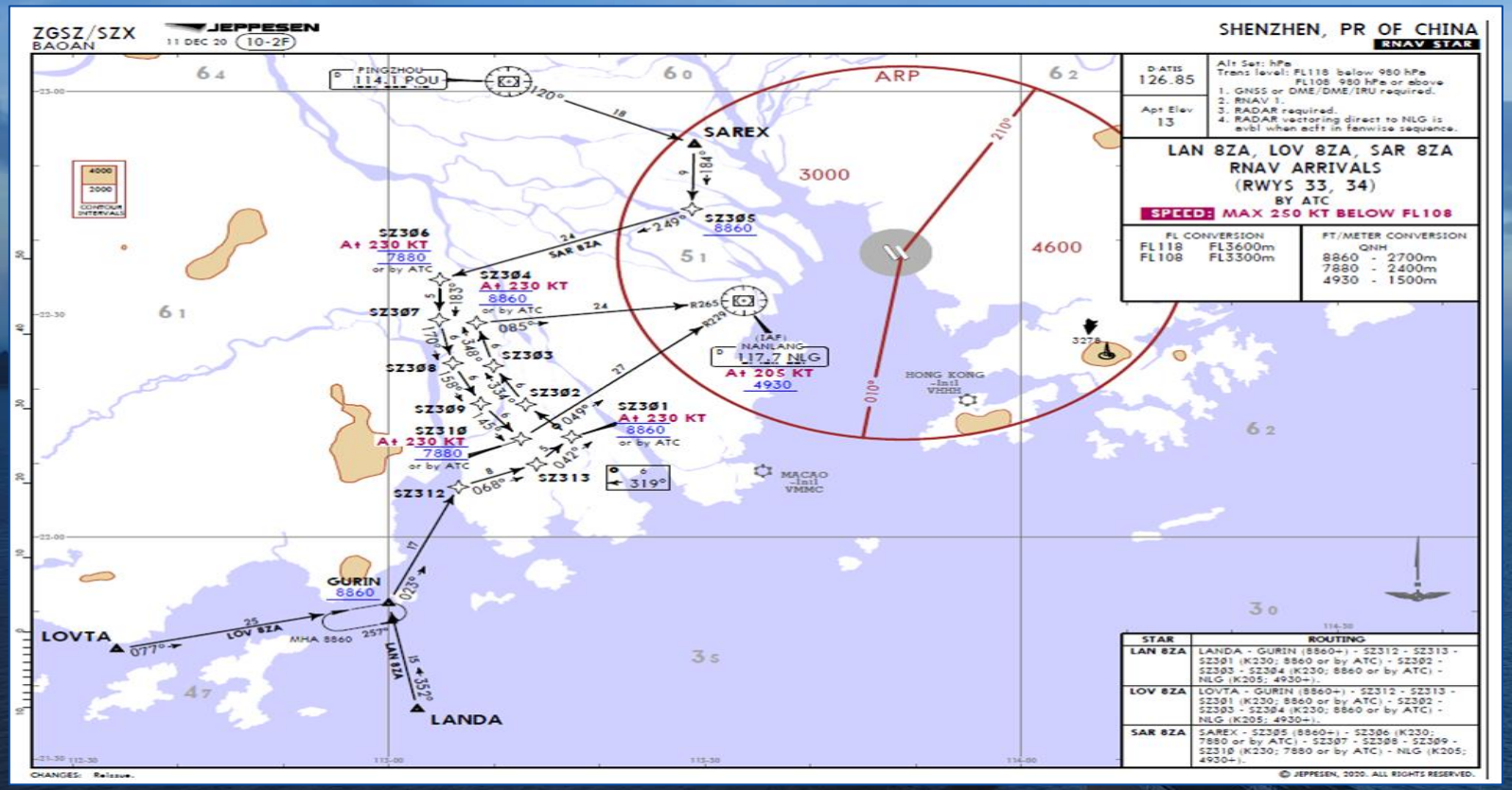
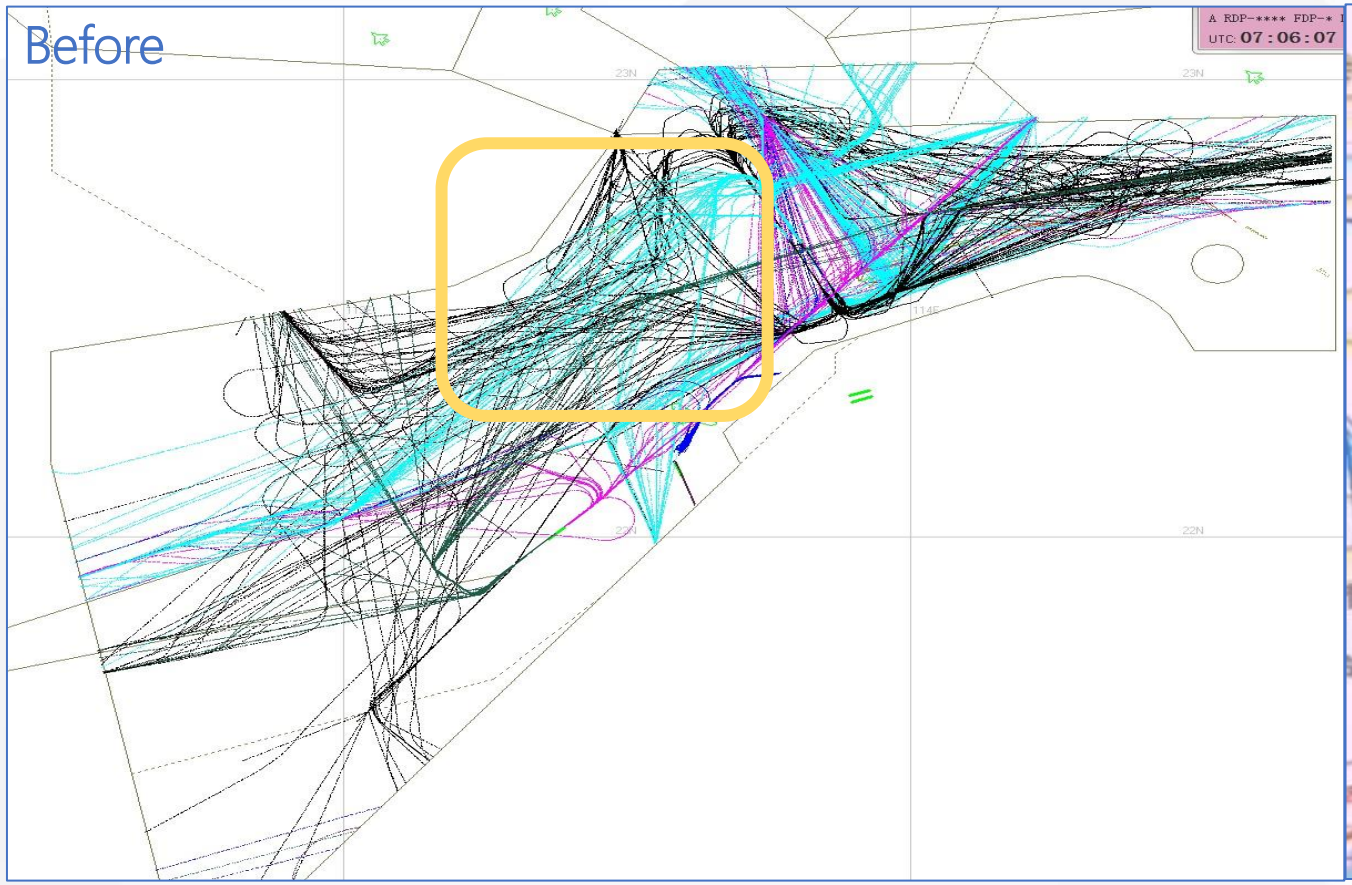
Shenzhen Bao’an Airport (ZGSZ) PMS

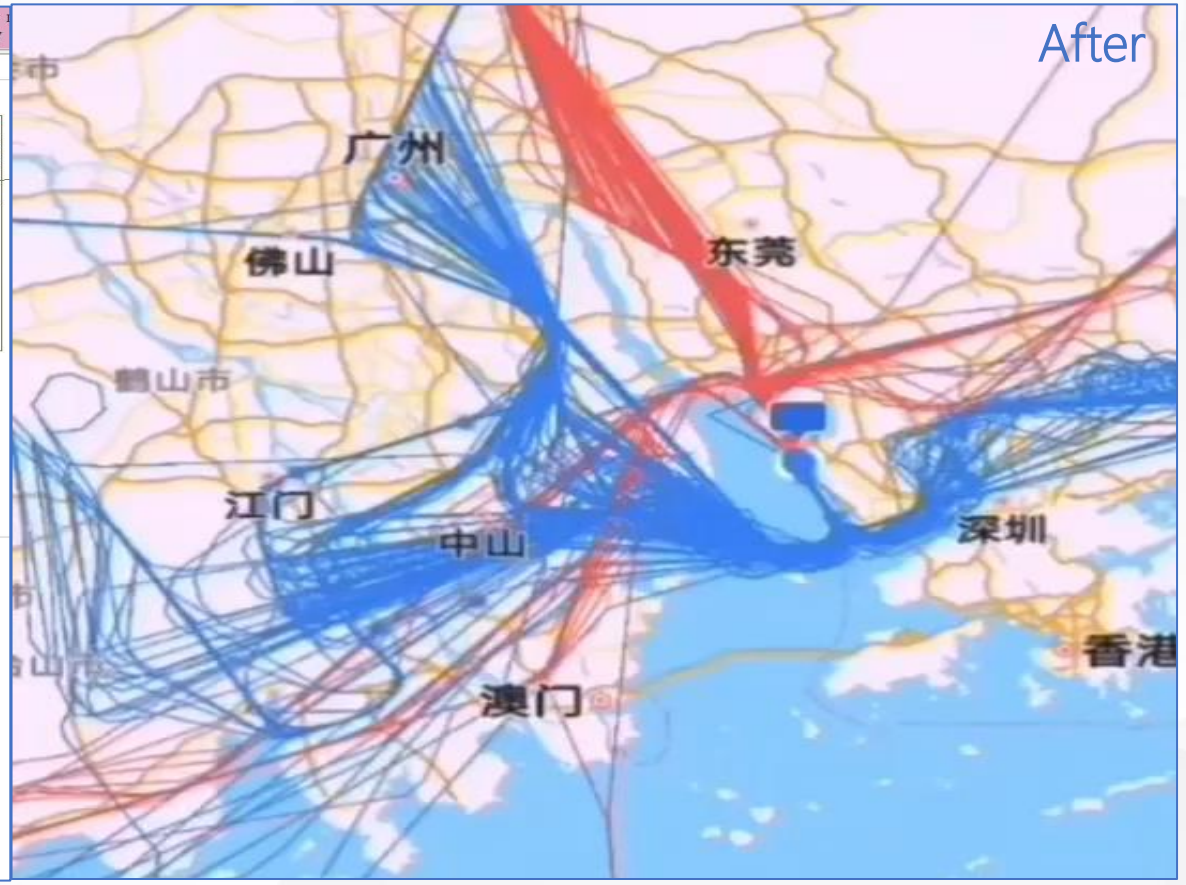


ZGSZ (RWY 15/16 33/34) Officially implemented PMS Trail operation in Dec. 2020

Before and After the PMS Operation

Radar Tracks of Zhuhai TMA





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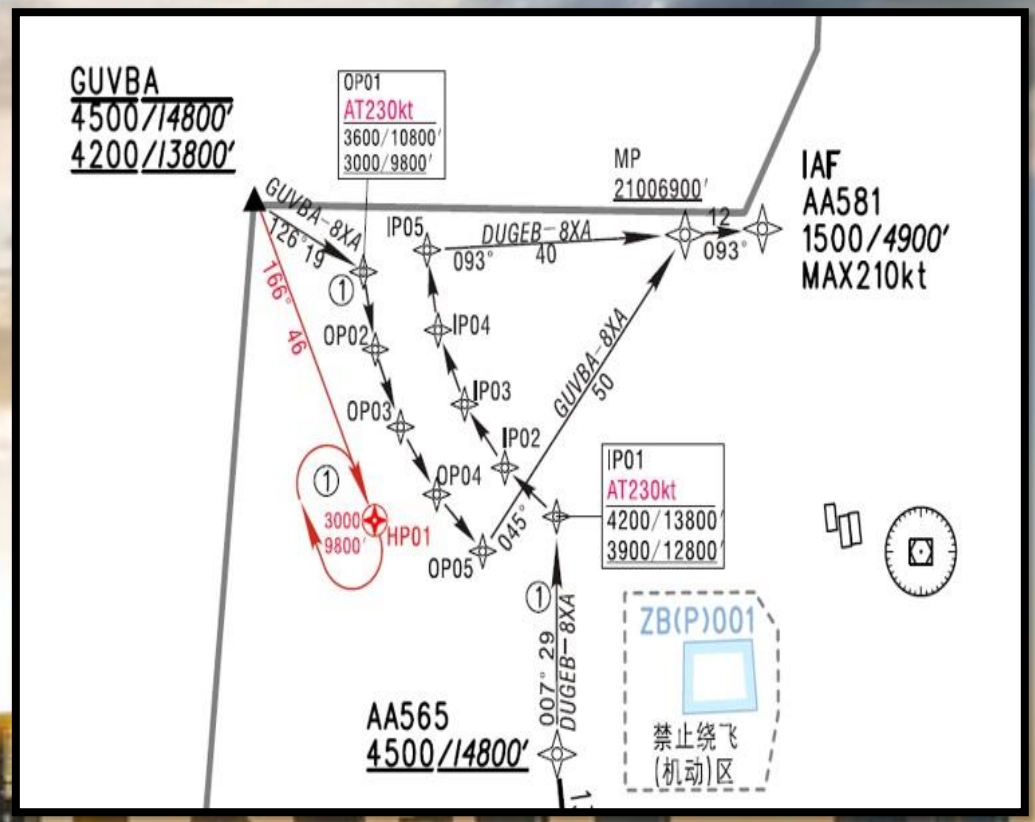
Beijing Capital Intl. Airport (ZBAA) PMS



ZBAA(RWY 18R) Officially implemented PMS operation in Apr. 2023

Validation and Evaluation Procedures

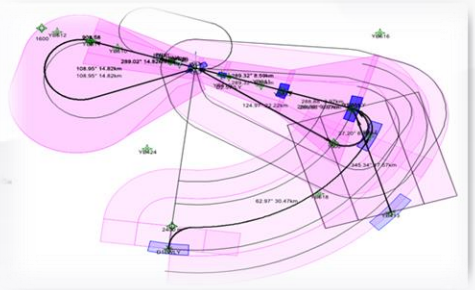
Ground Validation

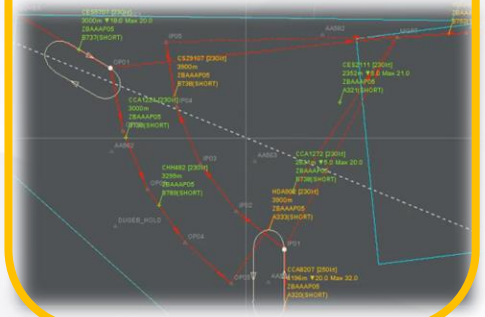
Expert Review

Fast time simulation

Flight Simulation

ATC Simulation





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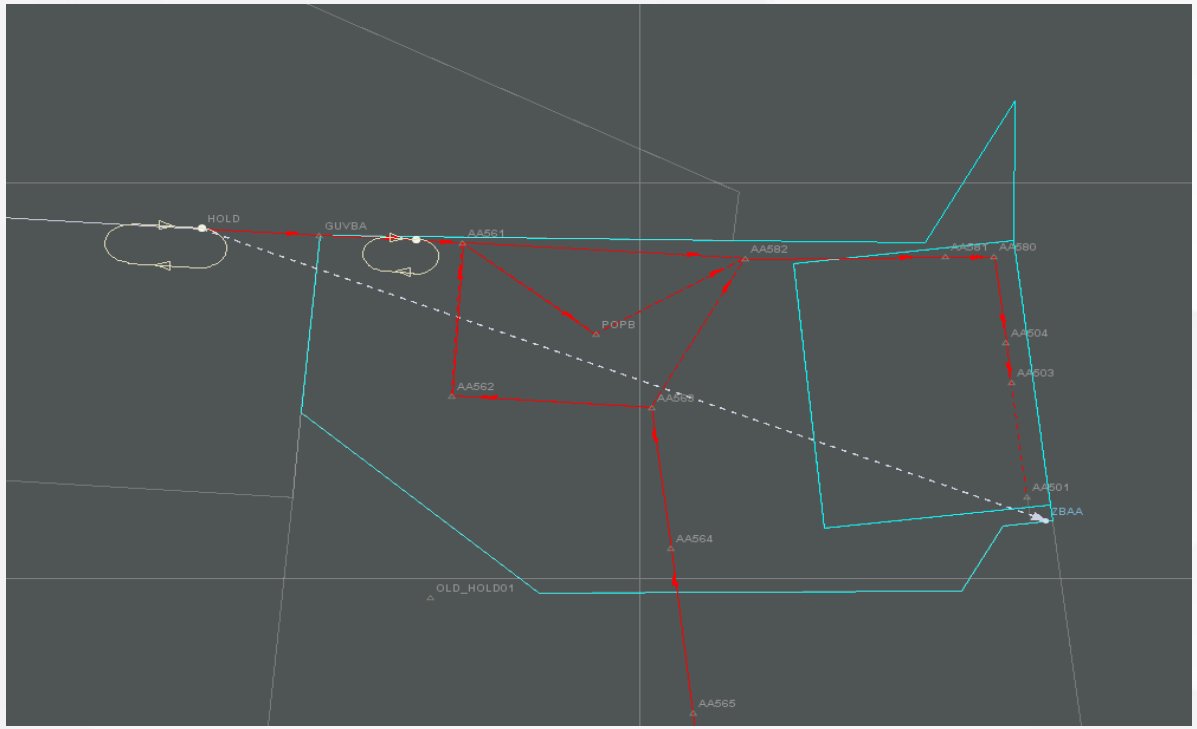
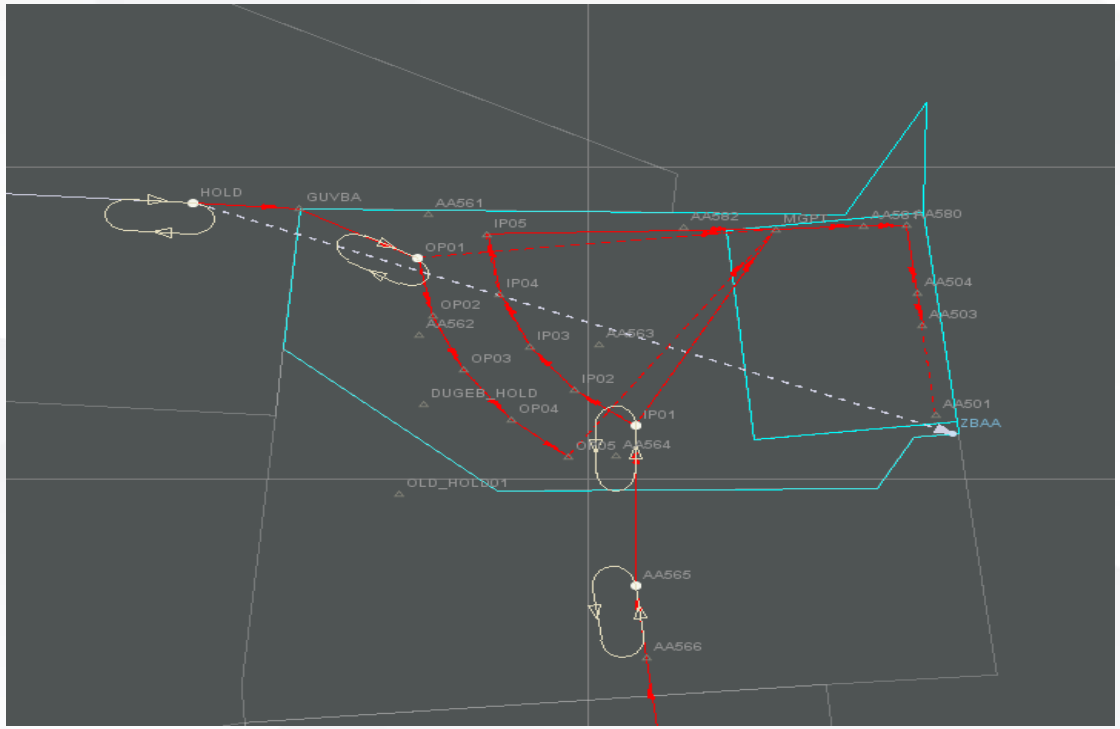
Fast-time Simulation and Evaluation on PMS in Beijing TMA

The airspace design team may use FTS prior to RTS as **the only validation tool**. FTS is often a **preferred method** for improving a proposed design, identifying flaws in a design concept and/or preparing the path to RTS or direct implementation.

------ICAO **Doc 9992** Manual on the Use of PBN in Airspace Design



Baseline



PMS/PMS+ model

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FTS JOINT TEAM

Airspace Management Center, ATMB

- Flight Procedure Design Office

  Airspace Design and Flight Procedure Design Experts

North China Regional ATMB (ANSP)：

- ATC Division - Airspace Design Experts
- Beijing TMA- ATC Experts
- Flight Procedure Design Experts

ADCC of ATMB：

- Airspace Management Department)

  FTS Technical Team

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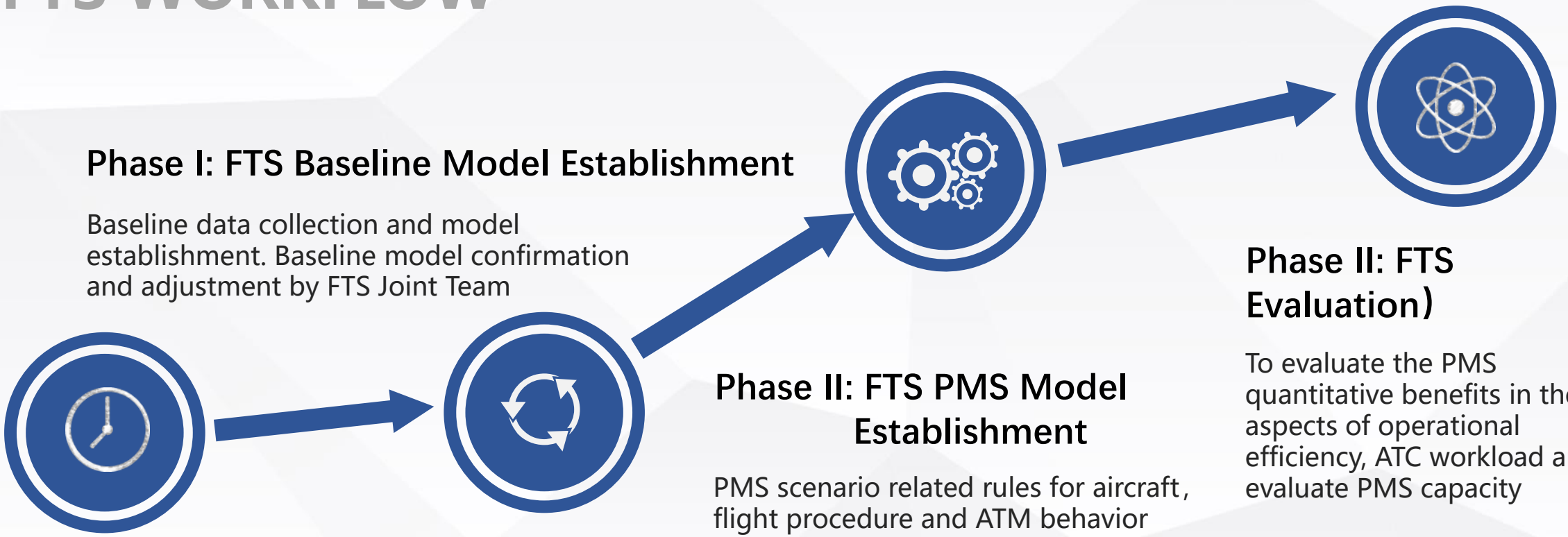
ADCC
民航数据通信有限责任公司
Aviation Data Communication Corporation

How to Perform FTS for PMS in Beijing

FTS WORKFLOW



Kick-off Meeting

Airspace Management Center, ATMB organized a kickoff meeting to communicate work plan and assignment with FTS Joint Team members

Phase I: FTS Baseline Model Establishment

Baseline data collection and model establishment. Baseline model confirmation and adjustment by FTS Joint Team

Phase II: FTS PMS Model Establishment

PMS scenario related rules for aircraft, flight procedure and ATM behavior input and PMS model establishment. PMS model confirmation and adjustment by FTS Joint Team.

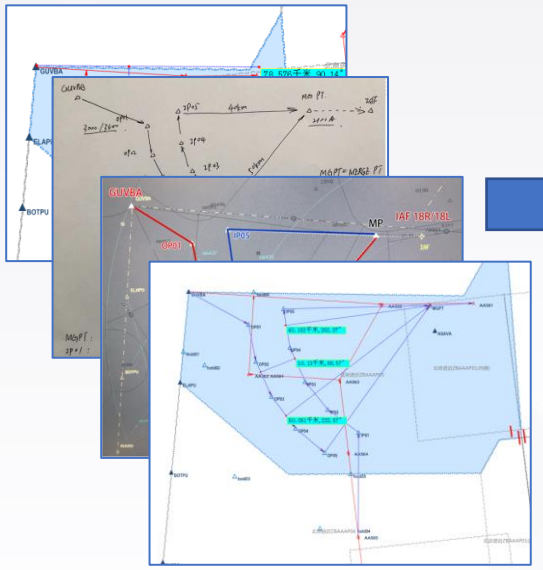
Phase II: FTS Evaluation)

To evaluate the PMS quantitative benefits in the aspects of operational efficiency, ATC workload and evaluate PMS capacity

How to Perform FTS for PMS in Beijing TMA

FTS INPUT

Determine the target airspace



FP after Ground validation

- Time Duration for Baseline and PMS Scenarios
- Traffic Sample
- Airspace Design
- Transfer of Control Procedure
- Vectoring Area
- Holding Procedure
- Speed Requirement
- Selected indicators

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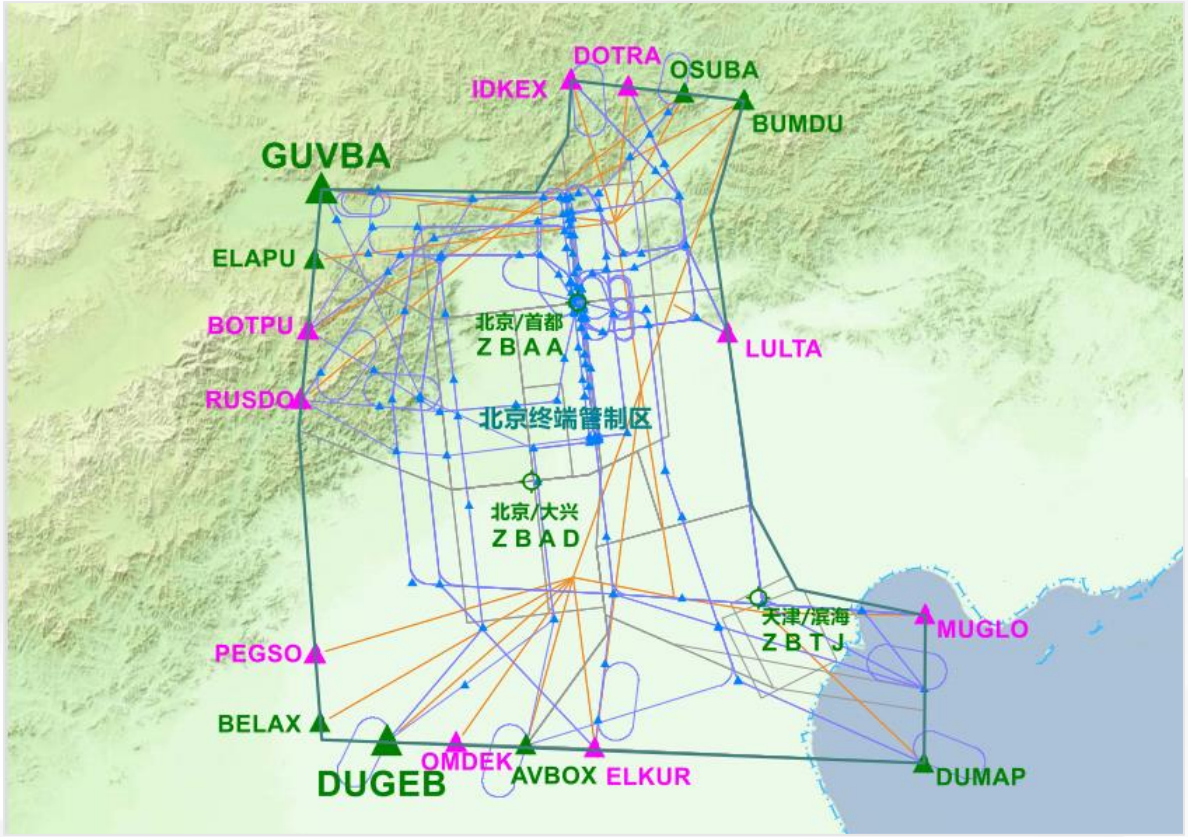
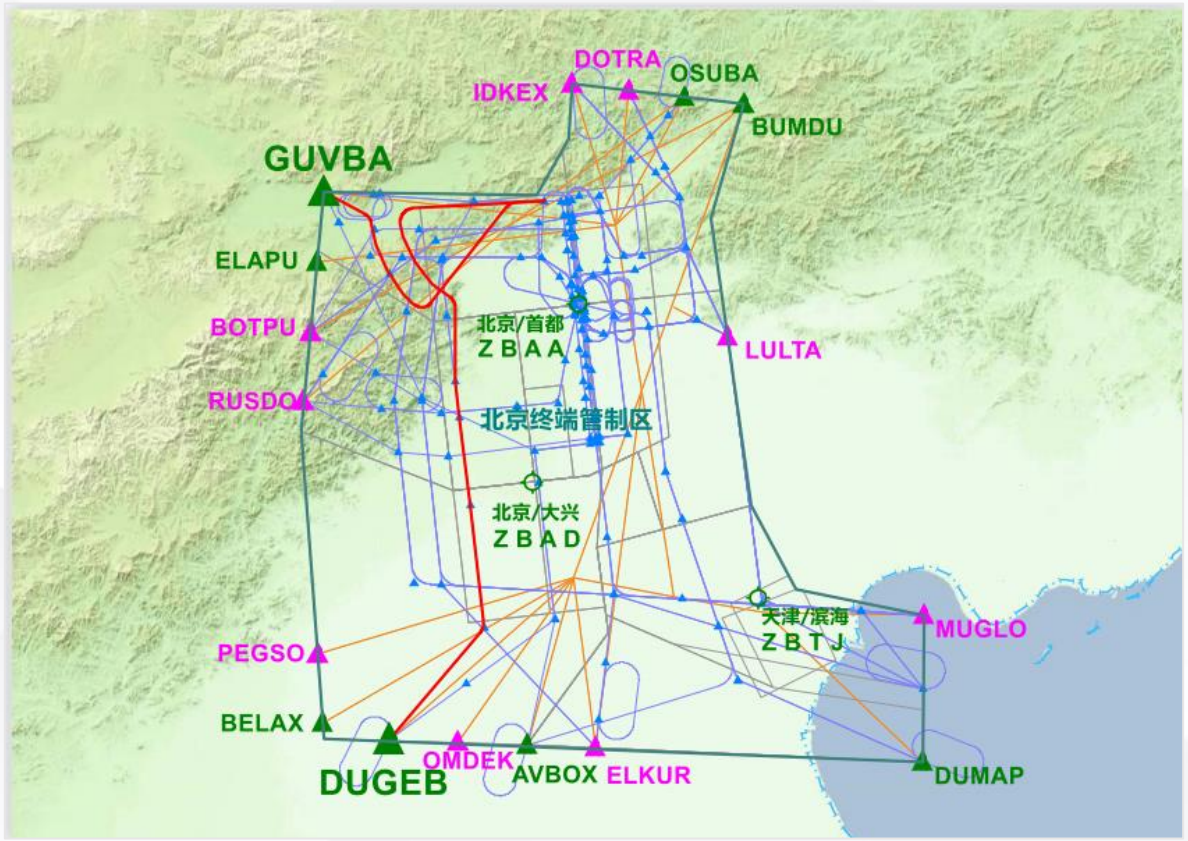
How to Perform FTS for PMS in Beijing TMA

FTS OUTPUT



Baseline Model



PMS Scenario Model

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Evaluation Results

95.3%	36.2%	23%	3.6min	2.4min
Reduced conflict frequency	**Reduction of air-ground communication**	**ATC workload reduction**	**Flight time reduction**	**Delay reduction**

It is estimated that the average flight time per sortie is reduced by 3.6 mins:

All flights within 3 hours of simulation period

The total flight time saved is about ***8.76h***

The total fuel saved is about ***23.2t***

Total carbon emission reduction is about ***76t***

The Benefits of PMS

- Reduce radar vectors
- Reduce ground-air communication
- Reduce operation conflicts
- Enhance Situation awareness
- No need to invest new facilities

Tip 1: Formulated Procedures and Joint Efforts

1 PMS Procedure Design

2 Fast-time Simulation & Evaluation

3 Examine & Revision

4 Simulate & Improve

5 Approve & Benefits Evaluate

6 Publication & Train

Approaching Success through Joint Efforts

Active participation of all relevant stakeholders, including Flight Standard Department of CAAC, ATMB Headquarter, Regional CAA, Regional ATMB, Airport Authority, Airlines and etc.

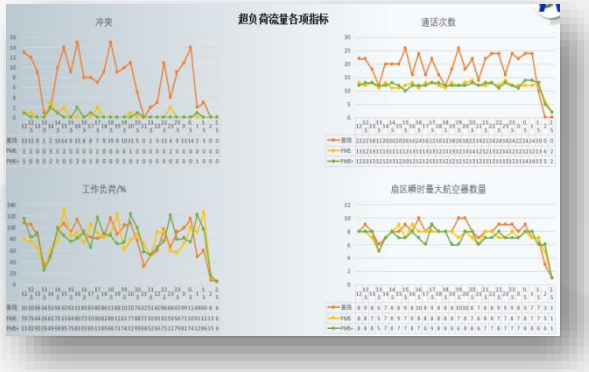
Tip 2: Fast-time Simulation is Helpful

To visualize and validate the airspace design concept

To establish situational awareness and enhance understandings of PMS scenario for ATC controllers

Provide Quantitative Support

ANSP **FTS Simulator**



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Future Plan

Expand PMS to other airports in both TMA and ACC

Assist countries in need for PMS research、design and validation

Thank you

Air Traffic Management Bureau, CAAC