International Civil Aviation Organization

Sixth Meeting of the Asia/Pacific Air Traffic Management Automation System Task Force (APAC ATMAS TF/6)

Bangkok, Thailand 2-4 June 2025

Agenda Item 5: **ATM Automation System Implementation Experience by States**

5.6 Development of New Technology

RESEARCH ON AMAN INTERCONNECTION IN ATM AUTOMATION SYSTEMS

（Presented by China）

SUMMARY

To solve the limited airspace resources in the terminal area, avoid the circling and holding of flights due to the increase in flight traffic, and enhance the close coordination and efficient cooperation among multiple control units, this paper proposes the interconnection technology of AMAN (Arrival Manager) between ATM Automation Systems (ATMASs), and introduces the research, testing and validation situation in China.

1 INTRODUCTION

1.1 AMAN is a decision-making tool that assists air traffic controllers in arrival sequencing. Terminal air traffic controllers use AMAN to negotiate the delay time of each flight phase with ACC (Area Control Center) air traffic controllers within the system. However, when the terminal areas operate as independent ATMAS, there is no solution available for how to collaboratively manage the arriving flights with adjacent control units to absorb the flight delay time before the flights enter the terminal area.

1.2 Currently, Eurocontrol provides flight arrival management services through API (Arrival Planning Information), which assists relevant departments and systems in the aviation field to plan and manage flight arrivals efficiently through submitting target times and other arrival information. Air traffic control authorities, airports and airlines have all obtained arrival flight information through this service.

1.3 Building on this foundation, China has advanced research on the collaborative management of arriving flights among different ATMASs of multiple control units. By expanding the inbound interaction protocol, which increases the interaction of 4D information and target collaborative hand - over time. It enables adjacent control units to collaboratively manage arriving flights, significantly reducing the circling and holding time of flights in the downstream terminal and approach control areas.

2 DISCUSSION

Overview

2.1 Realize the interconnection of arrival management between different ATMASs.

2.2 The upstream ATMAS outputs the basic flight information and the estimated handover time to the downstream ATMAS, which is used for the 4D trajectory update of the downstream ATMAS. The aim is to improve the accuracy of the 4D calculation of the downstream ATMAS and the consistency of the planning information between the upstream and downstream ATMASs.

2.3 The AMAN of the downstream ATMAS decides whether the upstream one needs to collaborate in arrival management according to the delay absorption capacity within the terminal/approach area and the overall delay situation of flights, and sends the calculated target handover time to the upstream ATMAS.

2.4 Upon receiving the target handover time, the upstream ATMAS independently absorbs the delay time within its own area according to the target time, and conducts the handover in accordance with the target time. This enables the upstream and downstream ATMAS to collaboratively absorb the delays of arriving flights in advance, effectively alleviates the circling and waiting of flights in the downstream terminal/approach area, and improves operational safety.

2.5 The overall coordination process is shown in Figure 1:

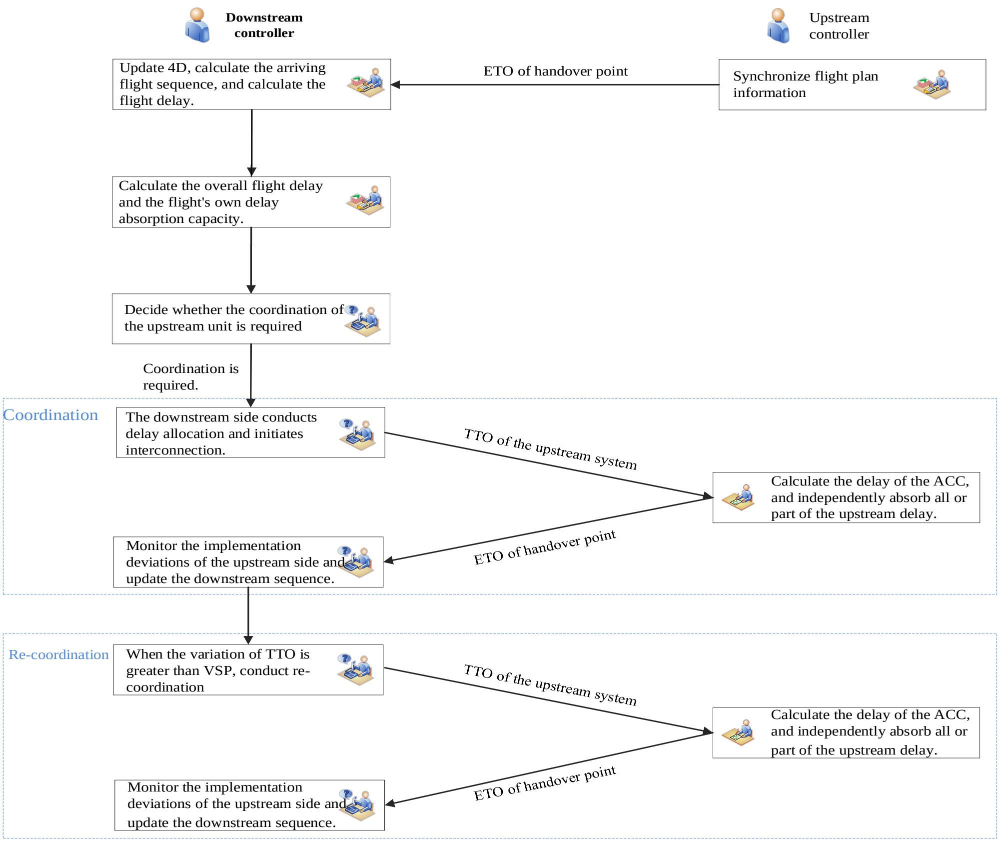

Figure 1 The Process of the Interaction Scheme

China conducts research and verification on the interconnection of AMAN

2.6 The Air Traffic Management Bureau of the Civil Aviation Administration of China launched the research work on the interconnection technology of AMAN between ATMASs in 2022. In 2023, interconnection testing and validation were carried out between Hangzhou and Nanchang. In 2024, interconnection testing and validation were conducted among Hangzhou, Nanchang and Hefei. The following takes the application in Hangzhou and Nanchang as an example, and introduces the implementation method of AMAN interconnection between the ATMASs of the two places from aspects such as the interconnection function switch, monitoring and alarm, 4D prediction information synchronization, interconnection and collaboration, and consistency monitoring.

Setting of the Interconnection Function Switch

2.7 Configure the interconnection switch within the upstream Nanchang ATMAS. It can be set online by air traffic controllers according to the operational situation, and the switch status is set to "off" by default. The downstream Hangzhou ATMAS synchronously displays the switch information set by Nanchang. The interface design of the interconnection function switch is shown in the following figure.

Figure 2 Interconnection Switch

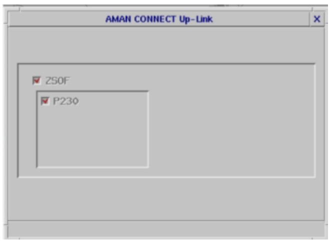

Figure 3 Setting of the Interconnection Handover Point

2.8 When the interconnection function switch is turned on and the link is normal, the interconnection mode is initiated. The upstream ATMAS receives the handover point time TTO (Target Time Over) issued by the downstream ATMAS, calculates the delay duration that needs to be collaboratively absorbed in advance within its own area according to the target handover time, and displays it on the track label.

2.9 When the interconnection function switch is turned off, the interconnection mode will not be initiated. The downstream ATMAS will no longer issue the target handover point time TTO to the upstream ATMAS, and the upstream ATMAS does not need to collaboratively absorb the delay duration of flights in this direction.

Monitoring and Alarm of the Interconnection Mode

2.10 The ATMAS in Nanchang and Hangzhou send interconnection link heartbeat messages, which are sent in the ADEXP format through the interface protocol. Maintenance personnel monitor whether the link is normal through the heartbeat messages.

2.11 For example, if the Hangzhou ATMAS does not receive the heartbeat message sent by the Nanchang ATMAS within the VSP time, it will determine that the interaction link is abnormal and issue an alarm prompt within the system. If the Nanchang ATMAS adjusts the interconnection switch mode, a pop-up window will also appear in the Hangzhou ATMAS to give an alarm reminder. The alarm information is shown in the following figure.

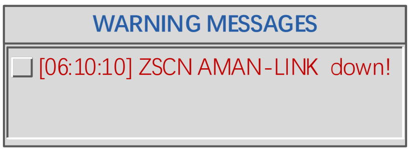

Figure 4 Interconnection Alarm Information

The upstream (Nanchang) system sends 4D prediction information (ETO) to the downstream (Hangzhou) system

2.12 The Nanchang ATMAS sends the 4D prediction information of interconnected flights to the Hangzhou ATMAS in the ADEXP format through the interface protocol. It mainly includes the ETO (Estimated Time Over) at the interconnection handover point. After receiving the ETO time issued by the Nanchang ATMAS, the Hangzhou ATMAS corrects the 4D trajectory information of the flights within the Hangzhou approach area based on this time, so as to achieve the synchronization of the 4D trajectory information of the two sets of ATMASs. The interaction content is shown in the following figure.

```
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 -SOURCE NUMEN3000@LES
 -FILTIM 061210
 -IFPLID 201332145
 -ADEP ZGGG
 -ADES ZSHC
 -ARCID INT0606
 -ARCTYP A319
 -CEQPT SRW
 -EOBD 20130106
 -EOBT 1135
 -SEQPT C
 -WKTRC M
 -TTLEET 0054
 -FLTRUL I
 -FLTTYP S
 -ISCOUPLE Y
 -ROUTE N0402F270 BPK UM185 CLN UL620 REDFA/N0390F230
 -ALTRNT1 EHRD
 -OTHERINFO PBN/B1C1D1O1S2 DOF/130106 REG/B1427 SEL/HMBK CODE/781164
RMK/TCAS II
 -SUPINFO E0745 R/VE S/M J/L D/2 8 C YELLOW
 -BEGIN RTEPTS
  -PT -PTID EGLL -FL F000 -ETO 20130106115100-ISPASS Y
  -PT -PTID BPK -FL F060 -ETO 20130106120245-ISPASS Y
  -PT -PTID TOTRI -FL F107 -ETO 20130106120605-ISPASS Y
  -PT -PTID ARTOV -FL F250 -ETO 20130106121400-ISPASS N
  -PT -PTID SHR -FL F230 -ETO 20130106122010-ISPASS N
  -PT -PTID EHAM -FL F000 -ETO 20130106124950-ISPASS N
 -END RTEPTS
  NNNN
```
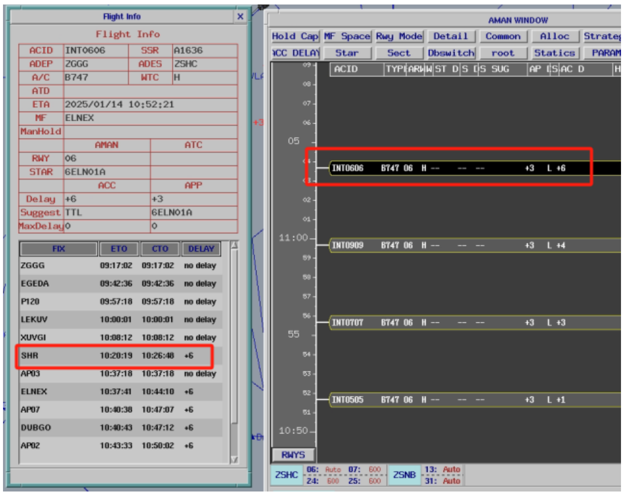

Figure 5 Synchronization of 4D Prediction Information

The downstream (Hangzhou) system issues the TTO

2.13 The AMAN integrated in the Hangzhou ATMAS manages the sequencing of all arrival flights to Hangzhou, calculates the CLDT (Calculated Landing Time) and delay values of the flights. For the delays that cannot be absorbed within the Hangzhou area, the Nanchang ATMAS needs to absorb the delays in advance in Nanchang. Therefore, the Hangzhou ATMAS issues the TTO of the flight handover point to the Nanchang ATMAS. For example, for flight INT0606, which lands in Hangzhou via Nanchang, and the interconnection handover point between Hangzhou and Nanchang is SHR. The TTO of the handover point issued by Hangzhou to Nanchang is 10:26, and the delay duration that needs to be absorbed in advance by Nanchang is 6 minutes.



ZCZC
-TITLE ITTO
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-IFPLID 201332145
-IFPLIDEXT 201332148
-ADEP ZGGG
-ADES ZSCN
-ARCID CCA434
-EOBD 20130106
-EOBT 1135
-ESTPTID SHR
-TTO 1026
NNNN

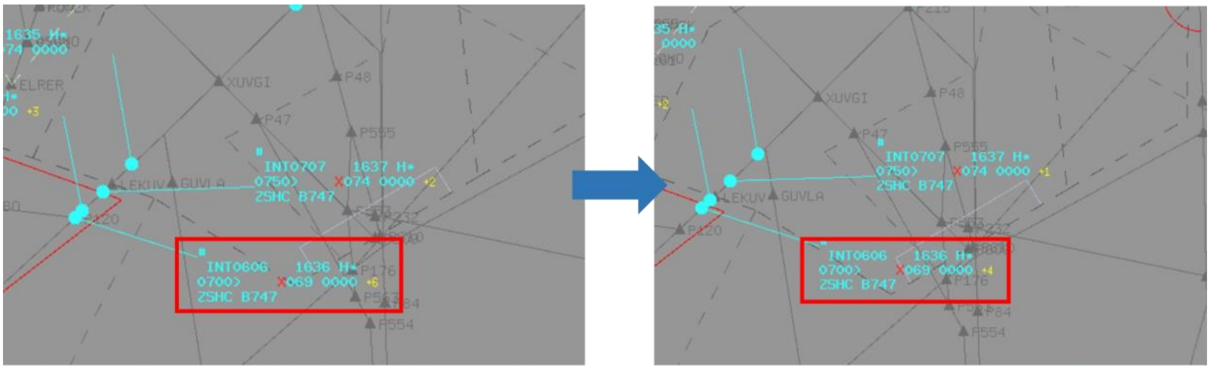
Figure 6 Figure 7

Figure 6 Hangzhou issues the TTO and delay information

Figure 7 Protocol for Sending TTO and Handover Point Information

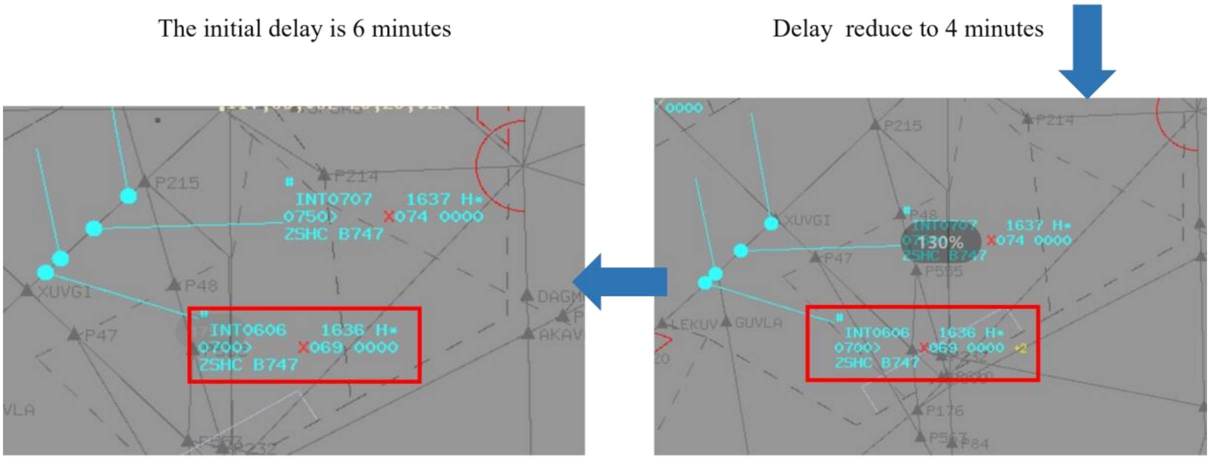
<u>The upstream (Nanchang) system receives the TTO</u>

2.14 The Nanchang ATMAS receives the TTO time, calculates the difference between the ETO and the TTO, which is the delay duration that needs to be absorbed, and displays it on the track label. For example, for flight INT0606, 6 minutes needs to be absorbed in advance. During the command process by the Nanchang air traffic control, the delay duration is gradually absorbed, decreasing from the initial 6 minutes to 2 minutes, and finally the handover is carried out according to the handover time TTO.



The initial delay is 6 minutes

Delay reduce to 4 minutes



The absorption of the delay complete

Delay reduce to 2 minutes

Figure 8 Nanchang receives the TTO and absorbs the delay

Consistency Monitoring (Re-coordination)

2.15 The Hangzhou ATMAS conducts real-time monitoring of the implementation effect of the Nanchang ATMAS. It calculates a new TTO based on the handover point time ETO sent by Nanchang. If the deviation between the new TTO and the old TTO exceeds the VSP setting, it will update and send the new TTO to the Nanchang ATMAS. For example, for flight INT0606, when changes occur during the monitoring operation, a new TTO will be reissued.

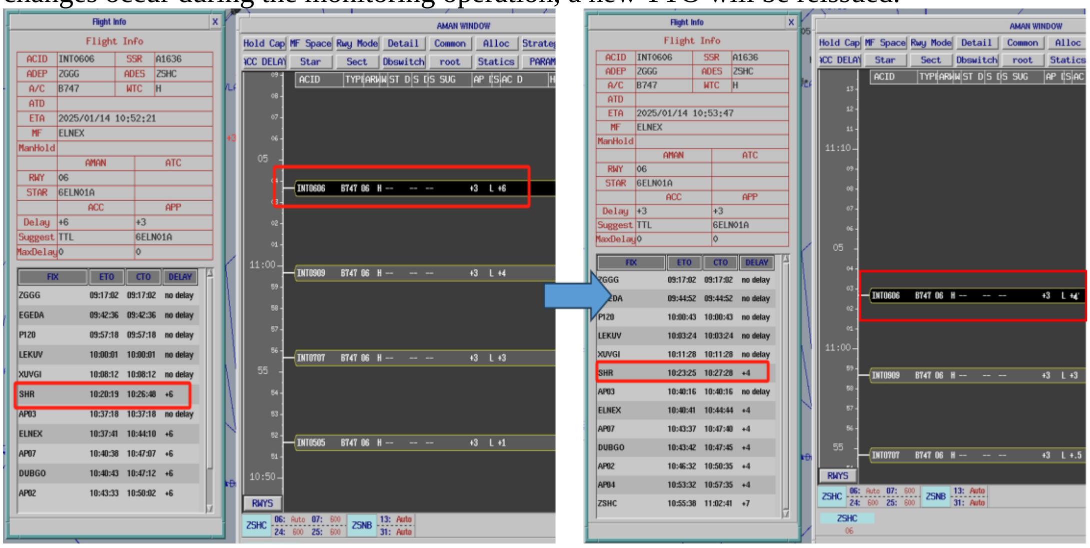


Figure 9 Consistency Monitoring

Conclusions and Suggestions

2.16 The testing and validation of AMAN interconnection in China have achieved excellent results and been highly recognized by air traffic controllers. It has broken the traditional voice communication and coordination mode with adjacent control units and established a new "silent digital" coordination mode. At the same time, the management work of inbound flights has been adjusted from the previous practice of making adjustments before entering the downstream terminal area to the sequencing process when entering the upstream control unit. Both the sequencing scope and the lead time of AMAN sequencing are earlier than before.

2.17 In the future, China will continue to promote the information interaction between the AMAN and the Air Traffic Flow Management (ATFM) system. The time calculated by the AMAN will be sent to the ATFM system to improve the accuracy of flight prediction information, providing effective data support for the formulation of traffic management strategies, and further enhancing the collaborative working ability of various air traffic control systems.

2.18 Global interconnection and sharing of AMAN information can be realized by expanding the FIXM format protocol. In this way, the collaborative operation capability of cross-border flights among countries can be enhanced, and further, the operational efficiency of air transportation in the Asia-Pacific region can be comprehensively improved.

3 ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the significance of AMAN interconnection in the ATMAS for the electronic handover coordination between adjacent control units; and

b) discuss any relevant matter as appropriate.

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