International Civil Aviation Organization

Seventh Meeting of the Asia/Pacific ATS Inter-Facility Data-Link Communication Implementation Task Force (APA TF/7) of APANPIRG

Video Teleconference,

Agenda Item 3: Sharing of experience on AIDC implementation and update the implementation status

RESEARCH ON ELECTRONIC HANDOVER TECHNICAL SOLUTIONS BETWEEN UPPER AND LOWER SECTORS

(Presented by China)

SUMMARY

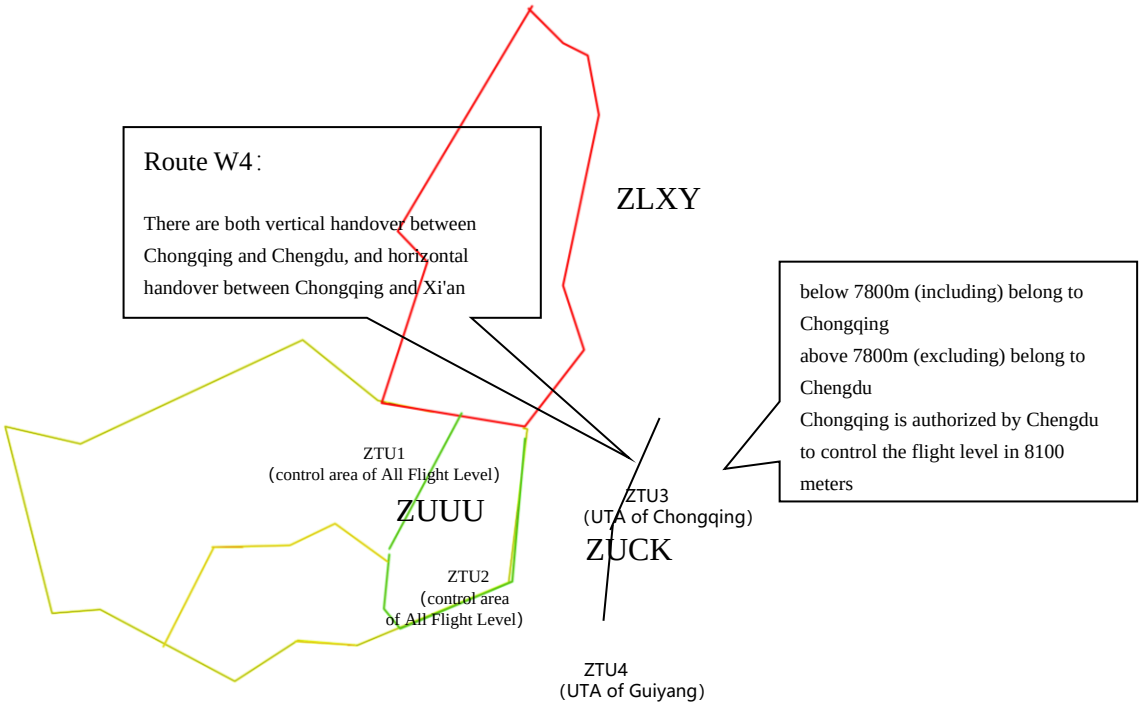
This paper introduces a complicated operational situation of horizontal and vertical handover co-exist, taking the flight handover between upper and lower sectors in Chengdu and Chongqing of CAAC, and the complex operational environment between Chengdu, Chongqing,and Xi'an as examples. Studies the application of MH/T4029.3, gives a solution of the horizontal and vertical electronic handover between adjacent control areas.

1. INTRODUCTION

1.1 High level airspace take-over is an important measure for CAAC to adjust its strategic airspace structure and optimize its airspace resource allocation, which plays a positive role in decomposing the increasing flight flow pressure of the airspace which is taken over. Before the integration of upper control area (UTA), aircraft belong to the same control unit no matter at high altitude or low altitude; After it, the changes in aircraft altitude means entering another control unit, which needs to be coordinated in advance, and then the aircraft can be transferred.

1.2 On March 18, 2015, Chengdu ATC took over all airspace above 7800m (excluding) in Chongqing. After Chongqing's high level airspace was taken over by Chengdu, Xi'an's airspace, which was only adjacent to Chongqing, was connected with the medium and low altitude control area of Chongqing and UTA of Chengdu at the same time, Vertical handover is added between Chengdu control area and Chongqing control area. In order to facilitate the handover between upper and lower sectors between Chengdu and Chongqing, Chongqing is authorized by Chengdu to control the flight level in 8100 meters. There are both vertical handover between Chongqing and Chengdu, and horizontal handover between Chongqing and Xi'an on the route W4 in the Chongqing control area.

The control area plan of Chongqing, Chengdu ,and Xi'an is as follows:



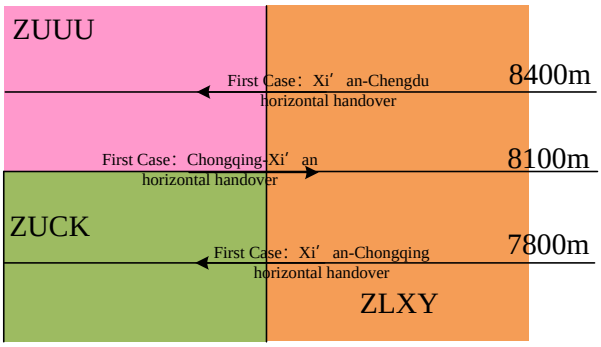
1.3 Taking Chongqing and Chengdu as an example, This paper introduces the complicated operational situation and requirements of horizontal and vertical handover in adjacent control areas, analyzes the difficulties of horizontal and vertical parallel implementation in adjacent control areas, gives a technical solution based on the application of MH/T 4029.3, to realize the vertical and horizontal electronic handover in the complex operational environment, The controllers can intuitively feeling of FDECM (the flight data exchange coordination message) screen handover between two ATC units is like being in different sectors of the same ATC automation system, the two ATC units do not need to define a fixed coordination point and the handover height in each ATC automation system, but can coordinate the handover height and handover time by HMI operation at any time, which has high flexibility.

2. OPERATIONAL REQUIREMENTS AND TECHNICAL SOLUTIONS INTRODUCE

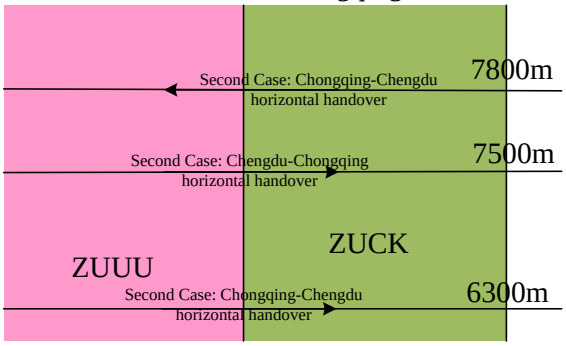
2.1 Inter sectors operation and demand analysis

After Chengdu toke over Chongqing's high level airspace, the overlapping and intersection of horizontal and vertical handover increased. There are horizontal handover between Chengdu UTA and Xi'an UTA, horizontal handover between low-altitude control area of Chongqing and Xi'an, vertical handover between Chengdu UTA ,and low-altitude control area of Chongqing. The three types of handover are:

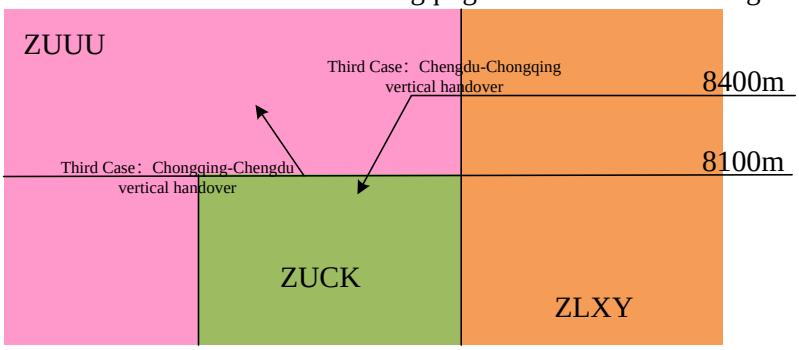
- Horizontal handover between Chongqing's low sector, Chengdu's high sector and ,Xi'an control area



- Horizontal handover between Chongqing's low sector and Chengdu's low sector



- Vertical handover between Chongqing's low sector and Chengdu's high sector



At present, the status of electronic handover between Chongqing, Chengdu ,and Xi'an airspace is as follows: AIDC is used for horizontal handover between Chongqing, Chengdu ,and Xi'an control areas, both vertical and horizontal handover between Chengdu and Chongqing control area are still done by telephone. Solutions are in urgent need for an operation to improve the level of security and operation efficiency.

2.2 Problems and solutions in Implementing electronic handover

2.2.1 Problems and difficulties

- Compared with the horizontal handover, the vertical handover between upper and lower sectors needs to coordinate the controller intention: the transferring unit would initiate the coordination request to command the aircraft ascend or descend at any time, and the receiving unit needs feedback the consent or refusal information according to its support situation. AIDC electronic handover process is based on a clear coordination point, and the coordinator message is sent at a relatively fixed time and location, which cannot meet the needs for different

control units of high and low sectors to trigger electronic coordination at any time and at any location.

- For the handover between Chongqing and Chengdu, horizontal and vertical handover coexist. Although the horizontal handover can be realized by AIDC, the vertical handover can only be realized by telephone due to the above problem. In order to avoid the potential risks caused by different operation modes of handover between the same adjacent control units, horizontal handover between Chongqing and Chengdu also maintains the telephone handover mode.

- At present, the automatic judgment of the receiving object in the ATC automation system is based on the calculation of the coordination point, XFL and 4D trajectory. There are both vertical handover between Chongqing and Chengdu, and horizontal handover between Chongqing and Xi'an on the route W4 in Chongqing control area.The command process is the same, and the XFL are both in 8100 meters. In this case, it is difficult for the ATC automation system to judge the receiving object.

2.2.2 Solutions

- Refine the process of flight electronic handover based on MH / T 4029.3. Formulate two phases: coordination and transfer of control, by using MH / T 4029.3. In the coordination stage, the message is used to coordinate the controller intention, and in the transfer stage, the horizontal and vertical handover are realized separately.

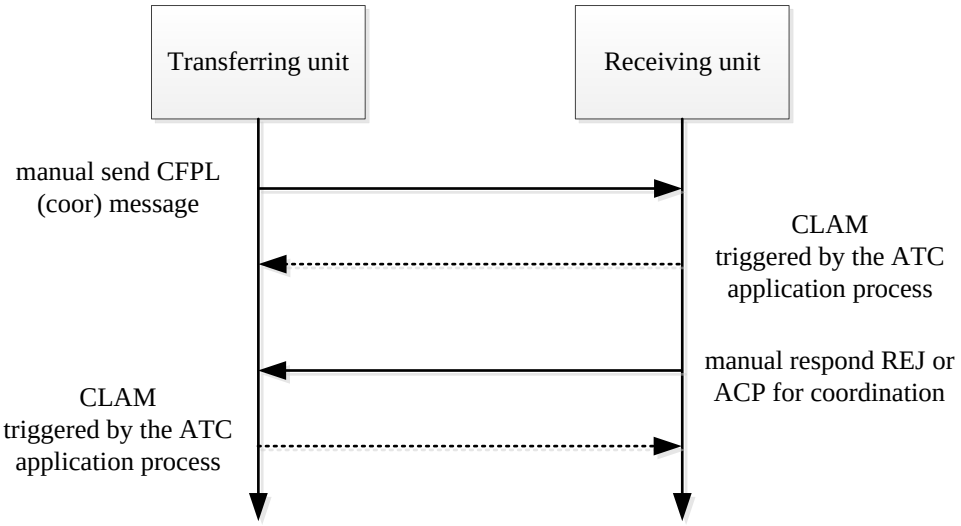
- Optimize the operation process of electronic handover in the HMI of ATC automation system. Because it is difficult for the ATC automation system to judge the receiving object and calculate the accurate coordination time, the technical solutions adopta simple operation in HMI, the transferring unit trigger the coordination artificially by determining the transfer flight level and sector, so as to prepare for the correct transfer of control in the next step.

2.3 Process design of electronic handover

According to the process in the solutions, it comprises two phases: coordination and transfer of control.

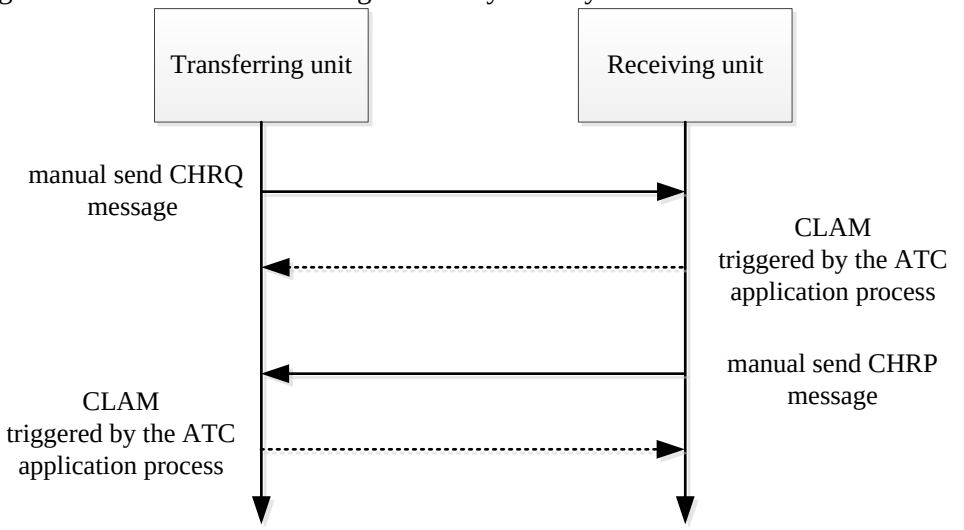
2.3.1 Coordination

This stage is used to let the receiving unit knows the intended transfer flight level from the transferring unit early, so as to help the two sides allocate the appropriate flight level for the aircraft in advance. Considering the staggering situation of horizontal and vertical handover, it is difficult for the system to judge the receiving unit through flight trajectory and XFL, and the controllers need the deal with the coordination time of vertical handover flexibly. Therefore, manual sending of coordination messages can ensure the accuracy and flexibility of coordination at the same time.



2.3.2 Transfer of control

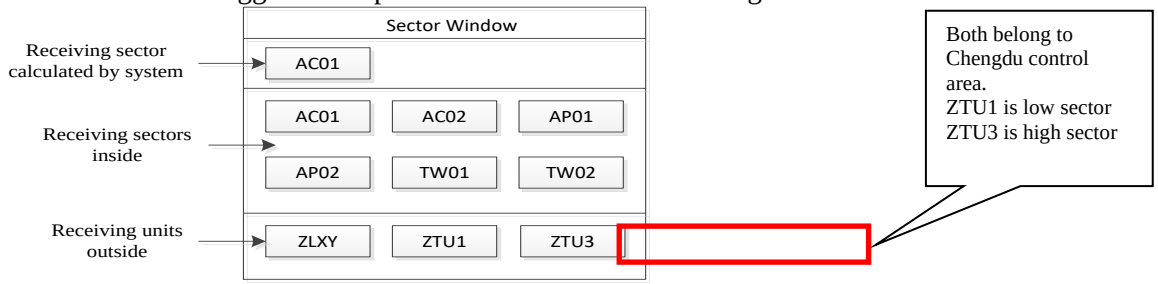
After the coordination is completed, the receiving unit and transfer flight level are defined, transferring unit sends the transfer message manually to carry out the transfer of control.



2.4 Design of controller operation

2.4.1 Coordination

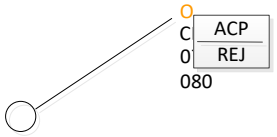
The transferring unit needs to set XFL manually on the HMI of the ATC automation system, and then select the coordination unit (including the adjacent ATC unit or a sector under the ATC unit) through the sector window to trigger the dispatch of the coordination message.



Taking Chongqing as transferring unit for an example, the operation and trigger of coordination message sending to Chengdu and Xi'an are designed as follows:

Direction	XFL Setting	Sector Window Operation	Messages Sending
ZUCK-ZUUU (vertical handover)	8100m	Select ZTU3	Sending Coordination message to ZUUU Coordination flight level is 8100m
ZUCK-ZUUU （horizontal handover）	7800m	Select ZTU1	Sending Coordination message to ZUUU Coordination flight level is 7800m
ZUCK-ZUUU （horizontal handover）	8100m	Select ZLXY	Sending Coordination message to ZLXY Coordination flight level is 8100m

After receiving the coordination message, there would be a coordination confirmation sign on the aircraft flight label for the receiving unit to acknowledge, and manually accept or reject to trigger the sending of a coordination response message.



2.4.2 Transfer of control

Through the coordination stage, the receiving unit has been identified. In this stage, the transferring unit does not need to select the receiving unit through the sector window, but can directly operate through the label, such as double-clicking the position of flight Call-sign on the label with the left mouse button to trigger the sending of transfer message.

When the receiving unit receives the transfer message, a receiving confirmation sign would appear on the label, and it can manually send an acceptance or rejection message through the label menu operation.

2.5 Solutions Summary

- In horizontal handover, the transfer stage is more important than coordination stage, the coordination phase is relatively simple through the pre-defined coordination point. The response of acceptance or rejection from the receiving unit can be directly reflected in the transfer process.

- In vertical handover, the coordination stage is more important than the transfer stage. Coordination can be trigger at any time according to the intention of controllers. The coordination process is the coordination of transfer timing. Both the transferring and receiving units need to use the coordination message to feedback their control intention in the coordination stage.

- At present, the domestic AIDC message application mostly adopts the simple model, but for the overlapping area of horizontal and vertical handover, the simple model cannot accurately reflect the control intention, but adopts the full mode, so the message interaction process is more complex. Based on the data of MH / T 4029.3, a simple mode electronic handover process can be designed to meet the needs of horizontal and vertical transfer overlapping areas.

- For horizontal and vertical handover to the same control unit at the same time, by unifying the horizontal and vertical handover operation in the HMI and using the same message interaction in the background of the system, the confusion of control operation can be effectively avoided, and the handover failure caused by human factors can be prevented.

3. CURRENT SITUATION AND NEXT STEP

3.1 Till now, the application of MH/T 4029.3 has realized the electronic handover between Xiamen and Fuzhou, Lanzhou and Xining, Due to the staggered horizontal and vertical handover between Chengdu and Chongqing, Chengdu and Guiyang, two phases including coordination and transfer are needed, and the coordination trigger time is more flexible. At present, ATMB of CAAC has completed the technical scheme design according to the characteristics of Southwest airspace.

3.2 follow-up plan of electronic handover based on the application of MH/T 4029.3:

- The functions of the software will be deployed in Chengdu and Chongqing ATC automation systems according to the technical solutions.

- Carry out handover test.

4. ACTION BY THE MEETING

4.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matter as appropriate

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