International Civil Aviation Organization

The Second Meeting of the Asia/Pacific Air Traffic Management Automation System Task Force (APAC ATMAS TF/2)

Video Tele-Conference, 14 - 16 September 2021

Agenda Item 4: ATM Automation System Implementation by States

4.2 System Operations, Enhancements and Maintenance Management Practices

EXPLORATION AND REALIZATION OF EFFICIENT UTILIZATION OF SSR CODEs

(Presented by China)

SUMMARY

As the number of flights continues to grow, the SSR codes are becoming increasingly scarce.This paper, from the spatial dimension and the time dimension, combined with China's practice in recent years, explores the way of efficient use of SSR codes suitable for China's national conditions.

1. INTRODUCTION

1.1 There are a total of 4096 SSR codes worldwide. The SSR codes used by Civil Aviation of China are divided into international inter-area codes, intra-area codes and domestic inter-area codes by the International Civil Aviation Organization. Among them, there are 927 international inter-area codes, 736 intra-area codes, and 448 domestic inter-area codes, for a total of 2111.

1.2 As the number of flights continues to grow, in the busy control center during peak hours, SSR codes are increasingly scarce. Although the application and promotion of S-mode radar and ADS-B nationwide in recent years has enriched aircraft identification information, the SSR code is still used as an important means of radar identification in radar control procedures, and its dominance is still unshakable.

1.3 This paper touched on the development history of domestic SSR code management in recent years, and the busy control center is constantly looking for solutions when facing code shortages. SSR code management experienced spatial dimension multiplexing time dimension reuse and reduction in the proportion of code time. At last, it looks forward into the future direction of practice.

2. SSR CODE ALLOCATION STRATEGY BASED ON THE SPATIAL DIMENSION

2.1 ORCAM (Originating Region Code Assignment Method)

a) Almost all the SSR code management mechanisms used in the early domestic ATM automation systems originated from ICAO's ORCAM (Originating Region Code Assignment

Method). ORCAM was first originated and used in Europe of which the design principle is the typical reuse of SSR code in the spatial dimension, so as to achieve the efficient utilization of the SSR code.

b) When flights fly over different control centers, ORCAM will perform SSR code retention judgments or reallocations based on the attributes of the inbound and outbound areas of the route. Therefore, when a flight is flying across flight information regions, the code needs to be changed frequently.To simplify the fight procedure, maximally maintain the SSR code, and reduce the conflict of code ,CAAC explores a "One Code to the End" path on the basis of ORCAM.

2.2 **The spatial dimension distribution strategy suitable for China**

a) According to the regulation issued by CAAC, when the flight is flying within the country, in principle, only one SSR code is used. The aircraft will keep this code until landing or flying out of the country.

b) According to the destination there are three categories:

- Destination in the local FIR
- Destination in China
- Destination in international

c) China simplifies ORCAM's procedure, for inbound flights, the SSR code is maintained as much as possible, if it cannot be the case, the special code is assigned. "One code to the end" simplifies the flight procedure, but it reduces the multiplex rate of the spatial dimensions.

2.3 **Spatial dimension expansion**

In the "One Code to the End" flight procedure, how to improve the utilization rate of the SSR code in the spatial dimension

a) **"Borrow SSR code"-** The Busy FIR (Flight Information Regions) borrows SSR code from the non-busy FIR. However, the borrowed codes will be assigned in two FIRs at the same time, resulting in the risk of air converge. In order to solve the potential air convergence risk caused by SSR code borrowing, a directional distribution measure is derived on the basis of borrowing.

b) **"The orientation distribution of SSR code"-**Directional allocation for the borrowed SSR codes. For example, the Shanghai FIR borrows the codesfromthe Urumqi FIR. For flights to Xinjiang, Shanghai ATM-AS will not allocated the borrowed codes.

c) **"The SSR code sharing"**-Code sharing for civil airports and cargo airports in close distanceTake the Wuhan Tianhe Airport and the Ezhou Huahu Airport as an example. The former is the civil airport, the code occupies mainly during the day, the latter is the freight airport, and the code occupation time is mainly at night.The two airports are 100km apart.The same code segment is used for civil Wuhan Airport during the day and Ezhou Airport for cargo at night.

3. EXPLORATION OF SSR CODE ALLOCATION STRATEGY BASED ON TIME DIMENSION

3.1 ATM-AS assigns the SSR code for the outbound flights according to the EOBT advance VSP time (generally set to 30 minutes). Take Chengdu Control Center as an example. There are a total of 53 domestic / international outbound flight codes that can be allocated in Chengdu Control Center. These codes will be used for the allocation of ZUUU and ZUTF airports and some other small and medium-sized

airports. The average flight time in Chengdu control center is about 1 hour and the East-West span can be up to 2 hours.

3.2 Figure 1 shows the actual 24-hour flight number of outbound flights from ZUUU airport which tells that the daily peak hours of outbound flights are concentrated from 6 am to 10 am Beijing time, and the number of outbound flights can reach 45. According to the data analysis, the code peak period of ZUUU airport is very scarce. In case of weather, flow control factors, the accumulation effect will make this time period no code to be assigned.

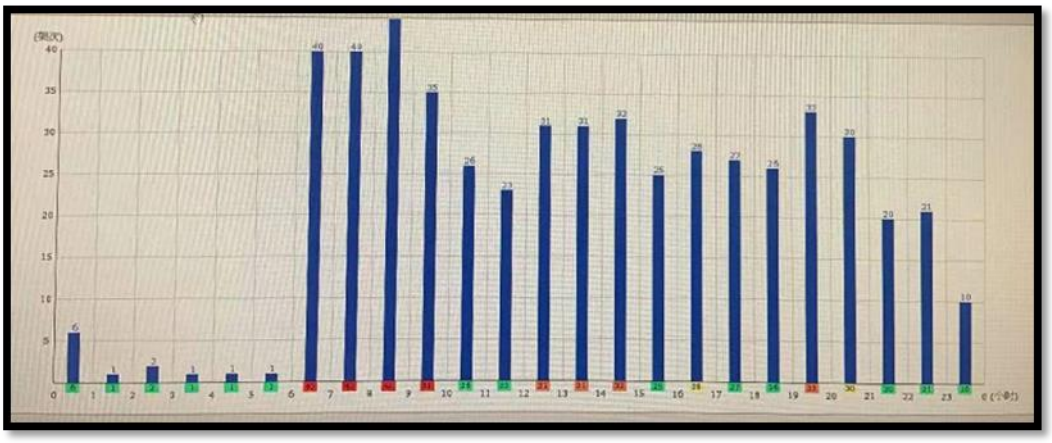


Figure 1

3.3 In order to alleviate the shortage of codes in ZUUU peak hours, the SSR code reuse mechanism was explored and adopted from the time dimension by ATMB.

Reuse the SSR code

3.4 Reuse SSR code- the SSR code of the flight can be allocated again, normally 30 minutes after the actual takeoff. Meanwhile, in order to reduce the coupling errors caused by the reuse, the SSR code can reuse only once, and prioritize the different direction flight.

Suspend the SSR code distribution

3.5 Suspend distribution of SSR code-Due to weather or flow control factors, if the outbound flight cannot take off normally, the SSR code allocation of outbound flights shall be suspended immediately. At this time, if the code is still allocated in advance according to the EOBT time, the code will be exhausted when the flight is cleared normally. In this situation, suspending the allocation of SSR codes for outbound flights is the most effective measure.

Request the SSR code allocation

3.6 Request the SSR code allocation- This is the most effective way to adopted in the time dimension that the SSR code allocation no longer rely on the EOBT time, but by the time receiving the clearance request from the pilot.The code will be assigned when the clearance sends by the tower controller. According to the actual use of the Chengdu integrated tower, the proportion of the invalid time of the SSR code has been greatly reduced.

3.7 According to statistics, when the number of flights is flat, the frequency of SSR code reuse has been reduced from 100% reuse every day every month to 5% daysevery month, which greatly improves the time efficiency of code use.

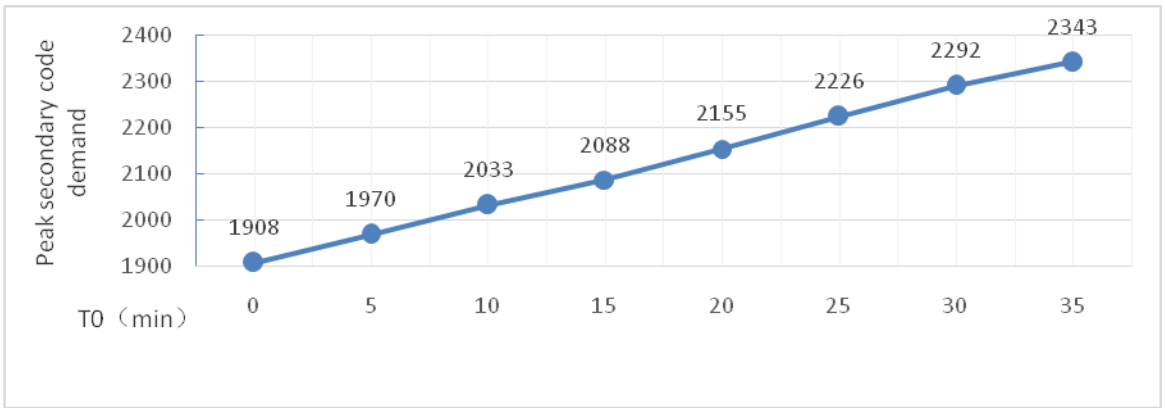
4. FUTURE PROPECTS

4.1 Refined exploration of time dimension allocation mechanism

a) As previously mentioned，the Tower ATM automation system of Chengdu Tianfu Airport and Chengdu Shuangliu Airport has been put into operation，and the SSR code distribution mechanism hasbeenchanged from time dimensions.Through the request distribution in the time dimension, the SSR code occupied time is effectively reduced.Cumulative peak demand for SSR codes decreased by an average of 18%.

b) According to statistics, after the request allocation mechanism was activated, there were only two no codes cases within a month. At that time, there were 21 SSR codes used for the departed flights, 27 SSR codes for ground flights, and 5 SSR codes for other airports in the control center.The occupancy of SSR codes for ground flights is the main factor limiting the efficiency of request allocation.

c) According to data analysis, for every 5 minutes that the SSR code occupancy time is reduced, the peak demand of SSR code is reduced by an average of 3.3%.



d) Since the time occupied by flights in the air cannot be shortened, reducing ground time occupation，such as starting the SSR code allocation when flights enters the runway is the direction of future exploration and practice.

4.2 Radar recognition with richer aircraft information

With the widespread application of ADS-B and S mode radars, CAAC will gradually standardize the use of aircraft callsigns and 24-bit address codes, formulate detailed radar control procedure that do not rely on SSR codes, and actively explore and optimize recognition procedures.

5 ACTION BY THE MEETING

5.1 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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