



ICAO

*International Civil Aviation Organization***Fourth Meeting of the Asia/Pacific Air Traffic  
Management Automation System Task Force (APAC  
ATMAS TF/4)***Bangkok, Thailand, 28 – 30 June 2023*

Agenda Item 4: ATM Automation System Implementation Experience by States

4.1 ATM Automation System Implementation Issues sharing

## OPTIMIZATION AND APPLICATION OF SSR CODE ALLOCATION IN ATMAS

(Presented by China)

### SUMMARY

Based on the actual operations and the discussions about efficient utilization of SSR code at ATMAS TF/2, this paper explores an efficient way to alleviate SSR code shortage. At last, the prospect of optimization method is proposed.

## 1. BACKGROUND

1.1 At the ATMAS TF2, the paper *“IP06\_CHN Exploration and Realization of Efficient Utilization of SSR Code”* was introduced to achieve efficient utilization of SSR code from spatial dimension and time dimension. The integration of spatial dimensions requires differences in time dimensions to achieve the most perfect opportunities. Therefore, it is more effective to optimize the time dimension under the current operation.

1.2 This paper extends the results of the previous discussion to explore the optimization of SSR code allocation strategy in the time dimension. It shows how to alleviate SSR code tension by improving time efficiency and reducing occupation time on the ground. At last, this paper presents the prospects for future optimization directions.

## 2. SSR CODE ALLOCATION STRATEGY

### 2.1 CURRENT ALLOCATION STRATEGY

2.1.1 Taking Chengdu APP Center as an example, there are a total of 110 SSR code resources used for the departing allocation, including Tianfu Airport, Shuangliu Airport and other Airports in the region. With the putting into operation of the Tower ATMAS, the SSR code allocation of Tianfu and Shuangliu Airport has changed to the moment when receiving the DCL request time of the pilot. Other airports have also adjusted to allocate SSR code by application. In addition, 20 min after the actual departure of flights, the SSR code can be allocated again in different directions.

2.1.2 Based on the measures above, Chengdu has already achieved reuse and request assignment of SSR code in the time dimension. However, it is still possible that departure flights have no available SSR code during peak hours. According to the working procedure in Chengdu, the ATMAS will allocate the special code 2000 for departure flights when SSR code are exhausted. For all flights with SSR code of 2000, controllers are required to have manual confirmation whether the ATMAS can allocate an available SSR code.

2.2 ACTUAL IMPLEMENTATION

2.2.1 Fig.1 shows the allocation of SSR code in Chengdu. According to the daily statistics, the SSR code occupation on the ground is an average 42% of the total. During peak periods, the occupancy rate can reach up to 77%. The high occupancy rate is the main reason for the resource shortage during peak periods.

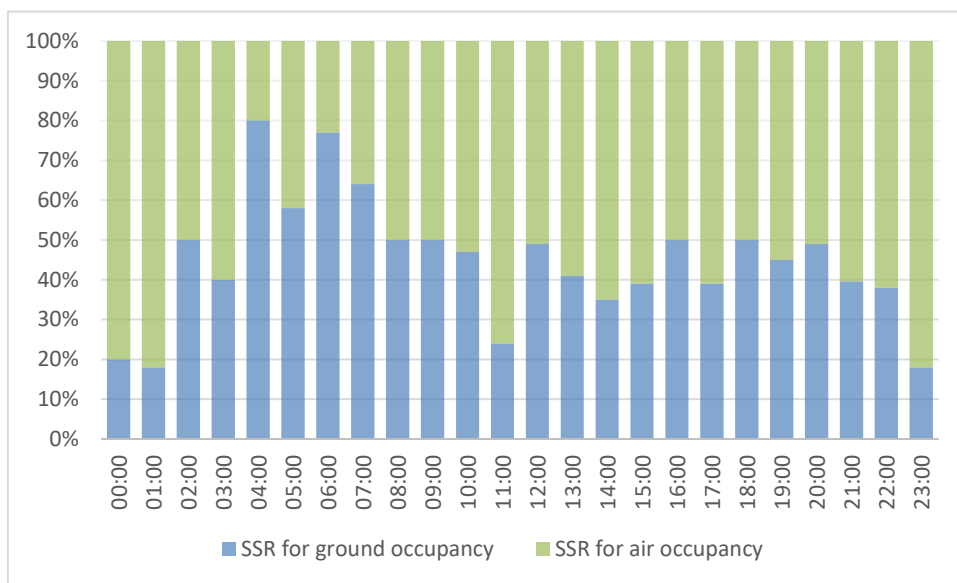


Fig.1 ALLOCATION OF SSR CODE IN DIFFERENT PERIODS

2.2.2 Tab.1 shows the statistics on the ground occupation time for departing flights after the allocation of the SSR code. According to statistical analysis, flights with allocated SSR code always stay on the ground for approximately 30 to 40 minutes until the actual departure, increasing invalid occupancy time. And there will be a further increase in the ground occupation in the event of an unexpected situation, such as delayed pushing-starting or temporary flow control. In the peak periods, controllers will use manual application mode to apply for SSR code, which further increases the burden.

Tab.1 OCCUPATION TIME ON THE GROUND OF DEPARTURE FLIGHTS WITH ALLOCATED CODE

Callsign	DEP	ARR	allocated SSR code	clearance	Ready	Push	Apron taxiing	Ground taxiing	Line up	Take off	Occupancy time (min)
TEST001	ZUUU	UUEE	21:20	21:41	21:45	21:47	21:53	21:55	22:02	22:04	44
TEST002	ZUUU	ZWWW	22:28	22:30	22:43	22:44	22:49	22:54	22:58	23:00	32
TEST003	ZUUU	ZBTJ	22:36	22:52	22:53	22:54	23:00	23:03	23:12	23:13	37
TEST004	ZUUU	ZUBD	23:05	23:06	23:07	23:30	23:36	23:38	23:44	23:45	40
TEST005	ZUUU	ZSPD	23:01	23:04	23:20	23:20	23:24	23:29	23:34	23:36	35
TEST006	ZUUU	ZPPP	04:25	04:40	04:43	04:43	04:48	04:51	04:53	04:54	29
TEST007	ZUTF	ZYCC	00:12	00:22	00:35	00:37	00:43	00:53	01:00	01:02	50
TEST008	ZUTF	ZHSY	01:50	01:53	02:12	02:14	02:21	02:27	02:28	02:29	39
TEST009	ZUTF	ZSYN	00:47	00:53	01:02	01:06	01:11	01:15	01:17	01:18	31
TEST010	ZUTF	ZJHK	00:52	00:55	01:07	01:14	01:19	01:23	01:27	01:29	37
TEST011	ZUTF	ZLIC	22:32	22:43	22:45	22:47	22:54	22:57	23:02	23:03	31

TEST012	ZUTF	ZYTX	02:36	02:52	02:53	02:57	03:04	03:06	03:10	03:11	35
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### 3. OPTIMIZATION OF SSR CODE ALLOCATION STRATEGY

#### 3.1 OPTIMIZATION ALLOCATION STRATEGY

3.1.1 The above analysis shows that the amount and occupation time of SSR code during the ground phase is the main reason for the shortage. Due to the particularity of tower control, the main optimization method is reducing invalid occupation time on the ground.

3.1.2 According to Tab.1, it can effectively reduce occupation time on the ground by delaying SSR code allocation. Considering the actual operations, the optimized SSR code allocation should include the following contents:

- a) Before actual allocation, the ATMAS needs to assign a unified SSR code to obtain digital clearance. This unified SSR code is called a pre-allocated SSR code (the allocation timing and unified SSR code can be configured).
- b) When the status of the flight plan is consistent with the timing of actual allocation ( configured ), the ATMAS needs to automatically allocate SSR code to avoid manual operations of controllers.
- c) In actual operations, some flights with allocated SSR code may need to go back to the parking stand. When the status of the flight plan returns to the timing before the actual allocation, the ATMAS will automatically release the allocated SSR code ( configured ).

3.1.3 In Chengdu, the Tower ATMAS is used to request for SSR code, and the ATMAS is used to allocate and release SSR code. The process is shown in Fig.2 where the solid lines represent the process of allocation and the dashed lines represent the process of release.

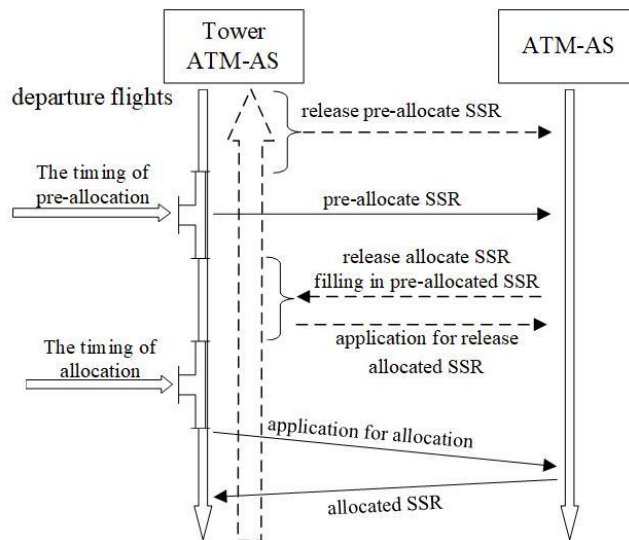


Fig.2 SSR CODE ALLOCATION AND RECYCLING IN CHENGDU

#### 3.2 OPTIMIZED SITUATION

3.2.1 According to SSR code manual operation mode, the Tower ATMAS is set to request for SSR code when the status of departure flights changes into the ground taxiing. When the ATMAS

operates at the allocation timing of the ground taxiing, the occupation time on the ground of the same flight will be significantly reduced in Tab.1.

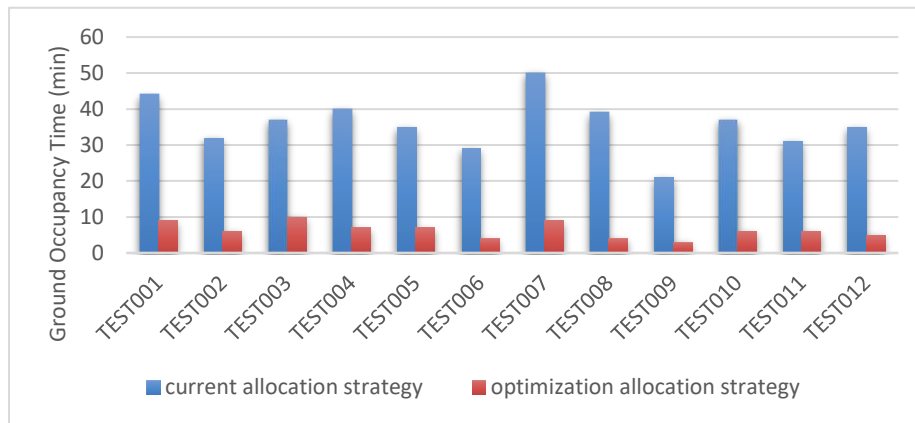


Fig.3 STATISTICS OF SSR CODE GROUND OCCUPANCY TIME

3.2.2 With the optimized allocation strategy during the peak hours, the SSR code occupation on the ground is an average 20% of the total. Compared to the previous occupation on the ground in Fig.1, the percentage decreased by 22%.

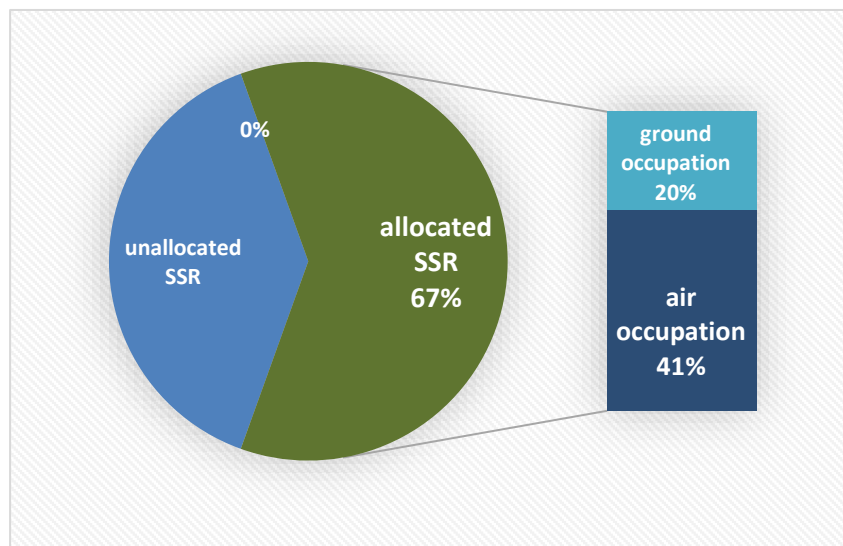


Fig.4 SECONDARY CODE ALLOCATION DIAGRAM

#### 4. FUTURE PROSPECTS

4.1 The Tower ATMAS will perform correlation when one of the following conditions is satisfied:

- a) SSR code and callsign of the track are consistent with the flight plan;
- b) The callsign of the track is consistent with the flight plan when the SSR code of the track is invalid;
- c) The callsign of the track is consistent with the flight plan when the flight plan without SSR code.

4.2 The correct correlation mainly relies on callsign and SSR code. According to the optimized allocation strategy, departure flights with pre-allocated SSR code can only be correctly

correlated through callsign. According to the ADS-B downlink report analysis, there are no mandatory procedures when the pilots allocate the callsign. When both the callsign and SSR code of the track are unavailable, controllers can only perform manual correlation instead of automatic correlation. In the long term, it is quite useful to issue a standard to ensure the accuracy of automatic correlation.

4.3 During optimized allocation strategy, callsign is the key factor for automatic correlation. In the long term, 24-bit address can be considered as the key factor of the correlation to avoid false correlations.

## **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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