International Civil Aviation Organization

Twenty Fifth Meeting of the Communications/ Navigation and Surveillance Sub-group (CNS SG/25) of APANPIRG

Video Tele-Conference, 18 – 22 October 2021

Agenda Item 6: Surveillance

6.2 Other surveillance related issues

MODE S ACTIVITIES UPDATE IN CHINA

(Presented by China)

SUMMARY

This paper presents a brief introduction of the Mode S related activities updated in China in recent years, and the Mode S activity plans in the near future.

1. INTRODUCTION

1.1 By introducing Mode S, the safety and efficiency of air traffic management have been greatly improved. In recent years, China has carried out a series of activities to promote the Mode S implementation.

1.2 Mode S may lower radar interrogation repetition frequency (IRF) to reduce potential 1030/1090MHz spectrum occupation, the data link capability may provide flexible aircraft parameter access, which will support air-ground coordination and finally improve the situational awareness, etc.

1.3 Due to the benefits brought by Mode S, China has been committed to advance the Mode S implementation. The related research and promotion activities mainly focus on avionic systems, surveillance systems, automation systems, spectrum analysis, and so on.

1.4 China will continue to focus on Mode S research and implementation, new functions will be tested and deployed, and system optimization will be conducted.

2. DISCUSSION

Avionic Systems

2.1 When realized that avionic system plays an important role in Mode S implementation, China conducted several researches on avionic systems, including the aircraft parameter data source survey and the aircraft parameter availability monitoring. The understanding of avionic system and related aircraft parameter information is the basis of Mode S implementation. Achievements were

shared during the Mode S DAPs WG meetings, and parts of them were integrated into the Mode S DAPs IGD document.

-refer to Mode S DAPs WG/2 IP05 "Preliminary Study of DAPs Data Sources"
-refer to Mode S DAPs WG/3 IP08 "Aircraft Parameters Availability in Mode S DAPs and ADS-B ADD"

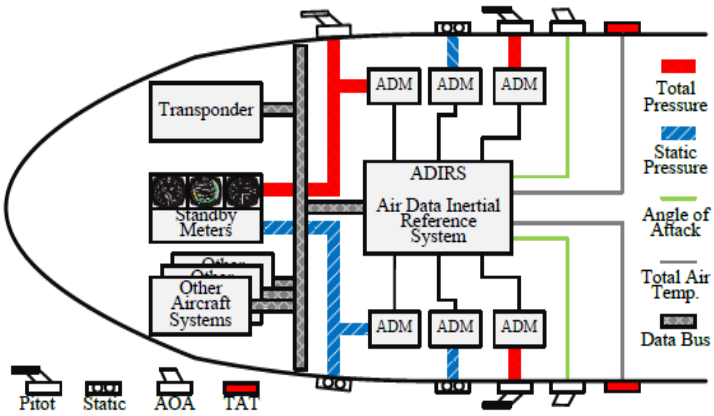

Figure 2-1 Avionic System Illustration

Surveillance Systems

2.2 China has deployed more than 70 Mode S radar sensors and more than 300 ADS-B ground stations, they are the main surveillance systems to be used to extract the aircraft parameters (technologies which also called SSR DAPs and ADS-B ADD). In order to improve the data extraction efficiency, the extraction strategy of Mode S radar had been researched, which focused on how different parameters will affect the operation of the radar, and related Mode S Parameters Set (MSPS) was defined to standardize the Mode S radar's operation. China will continue to share the information about the researches of Mode S radar sensors.

-refer to Mode S DAPs WG/2 IP07 "Considerations on Mode S Radar Interrogation Strategy"
-refer to Mode S DAPs WG/3 IP06 "Mode S Radar Parameter Set and DAPs Extraction Strategy"
-refer to Mode S DAPs WG/3 IP07 "A Method of Mode S Radar Roll-Call Scheduling Management"

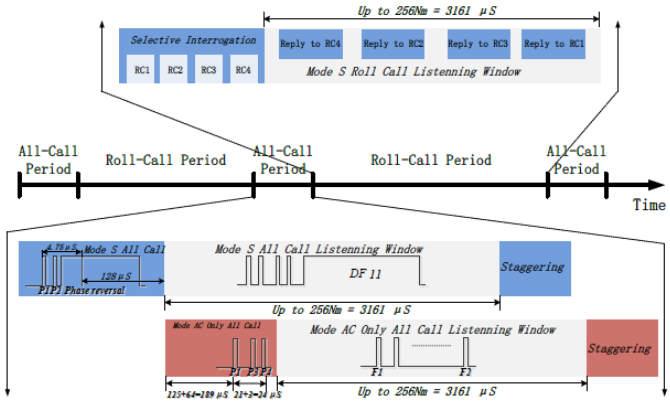

Figure 2-2 Mode S Radar Roll-Call Scheduling

2.3 According to the "5-year rolling plan" of CAAC, more than 38 Mode S radars will be introduced, and by the end of 2030, China will have around 220 Mode S radars. It's impossible to operate all the Mode S radars by II code, the SI code will be the solution, China hence conducted radar capabilities survey to support the potential future II/SI mixed operation. The survey covers all the Mode S radar models including Thales, Selex (Leonardo), Indra, Nriet, Suncreat and Jiuzhou, and

includes all aspects related to the operation of Mode S, such as the support for IC, the support for IC programming, the interrogation strategy, the lockout override capability and the processing of Non-SI transponders. Through the investigation, different design concepts had been noticed, and advices were fed back to the manufacturers. Achievements were shared during SURICG meeting.

-refer to SURICG/5 IP18 "Mode S Radar Survey to Support II/SI Mixed operation in China"

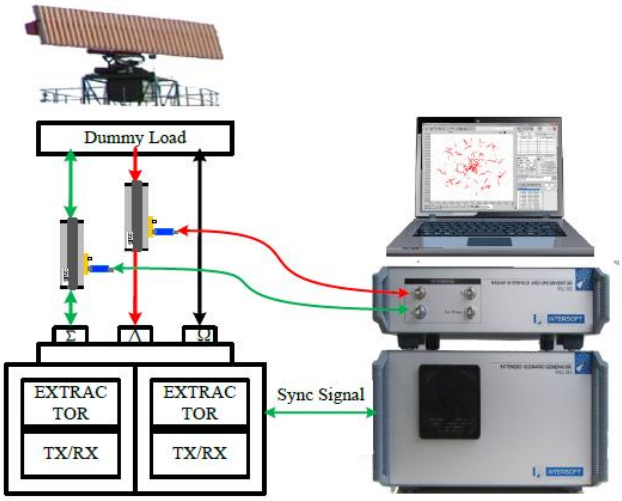

Figure 2-3 Mode S Radar Survey Test Bench

Automation System

2.4 China started the automation system upgrade from 2018 to make the system capable of using Mode S data from surveillance sensors, the upgrade contains 3 phases. The first phase had been finished by 10 Dec 2018, which enables the system to process DO-260 data. The second phase is still ongoing, which enables the system to process DO-260B data, and 1) using Aircraft Address and Aircraft Identification to identify related aircraft; 2) using Aircraft Address and Aircraft Identification to correlate track and flight plan; 3) extracting ACAS RA and display; 4) pilot instruction comply check; 5) SFL/CFL and BPS/QNH inconsistent check. The third phase will expand the Mode S data usage in the future.

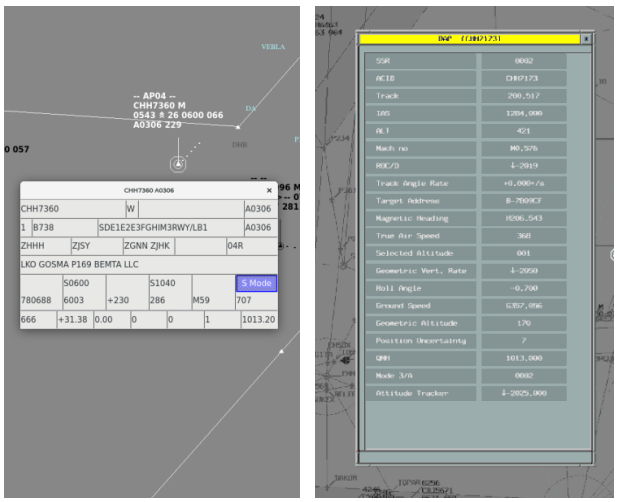

Figure 2-4 Automation System DAPs Window

Spectrum Analysis

2.5 Mode S and ADS-B application will increase the usage of 1090MHz, high efficiency usage should be ensured. The 1090MHz survey conducted at Beijing and Chengdu airport shows that the 1090MHz occupancy is not exceeding 10% at both airports.

-refer to Mode S DAPs WG/4 IP06 "Introduction to the Experiment of 1090MHz Occupancy at two Busy Airports in China"

ADS-B Implementation

2.6 China had been planning a national ADS-B project since 2016, which was composed of 308 ground stations and a 3-level network architecture to process and distribute the ADS-B data. All the installation, deployment, Site Acceptance Test (SAT) and flight inspection activities were finished in 2018. Initial operation for ADS-B service started at the beginning of 2019. Trial ADS-B operation started on July 2019. China issued the AIC (Aeronautical Information Circular) Nr.09/19 "Implementation of ADS-B Control Services" in the AIP in Oct 2019, the ADS-B control service started from 10 Oct 2019, and the ADS-B equipage minimum requirement is ADS-B ES Version 0 (DO-260). Aircraft operator complying with the ADS-B equipage requirements shall indicate the correct ADS-B designator in ITEM 10 of the flight plan. The implementation includes 2 phases according to the surveillance coverage capabilities, Phase I started from 10 Oct 2019 and Phase II started from 31 Dec 2020.

-refer to SEA/BOB ADS-B WG/15 IP08 "ADS-B Implementation Activities in China"
-refer to AIC Nr.09/19 "Implementation of ADS-B Control Services"

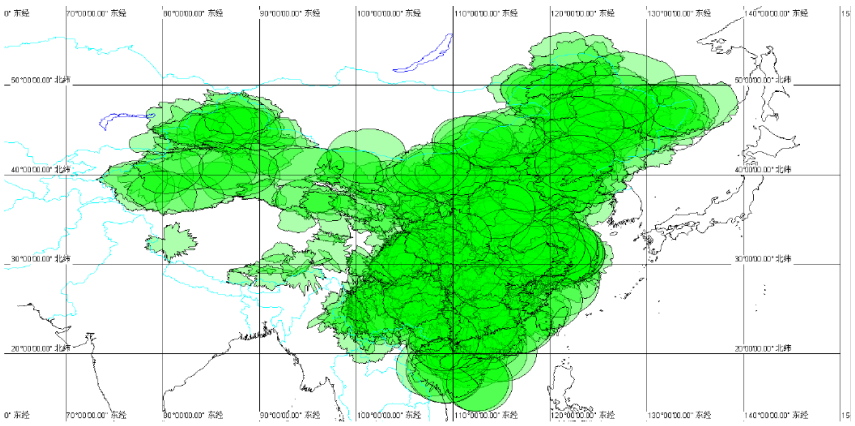

Figure 2-5 National ADS-B Coverage at 8400m

Mode S DAPs IGD

2.7 During Mode S DAPs WG/1 held in March 2018, a working team was established to develop the Mode S DAPs IGD, and China has volunteered to take lead on coordinating and consolidating inputs from members of the working team. China organized two internal conferences and ICAO APAC office organized a web conference for reviewing the contents. Based on numerous rounds of review and comments with joint efforts from the working team, China has revised the draft into five previous versions. Finally, the Edition 1.0 was submitted for endorsement after Mode S DAPs WG/2, and published in the CNS SG/23 report. China continued to revise the document and circulated it to the working group for comments. Edition 2.0 was released in 2020 during CNS SG/24, and Edition 3.0 is prepared and endorsed by Mode S DAPs WG/4.

Benefits Achieved

2.8 The use of Aircraft Address and Aircraft Identification (FLT ID) by Mode S greatly enhanced the target identification capability, and reduced the R/T. The automation system use Aircraft Address and Aircraft Identification (FLT ID) improved the accuracy of the association between flight track and flight plan, In Guangzhou ATC Center the association rate improved from 92% to greater than 99%.

2.9 The use of Enhanced surveillance, controller can check the indicated airspeed, Mach No., magnetic heading and RA information. It is beneficial to improve situational awareness. The Safety Nets were improved after the use of ADS-B and Mode S radar data. Target altitude accuracy increased to 25 ft., flight tracking accuracy improved. Ground-air information consistency monitoring function added, such as SFL/CFL inconsistent alarm can effectively reduce the Level Burst. In Guangzhou ATC Center this function deployed since the beginning of 2018, and the Level Burst have been reduced by more than 90%.

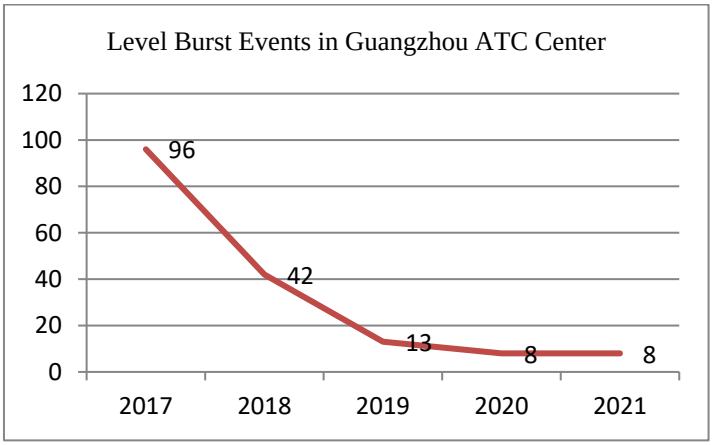

Figure 2-6 Level Burst Events in Guangzhou ATC Center

2.10 In recent years, airborne GNSS receiver interference occurred frequently, which had a great impact on the operation of civil aviation, in order to assist the detection of the interference, research were conducted on how to use ADS-B data to locate GNSS interference. The main contents include: 1) based on NUCp value in ADS-B data, big data technology was used to filter out data likely to be affected by interference, this work has been done, and an online system has been developed for the use of radio regulatory authorities; 2) based on the ADS-B data under interference, the location model of the possible interference source is still under study.

Future Activities

2.11 The new version of MOPS for 1090MHz ES ADS-B published in Dec 2020, China will organize relevant parties to carry out related research, and share the achievements in ICAO APCA region through relevant surveillance meetings.

2.12 In order to achieve more benefits of Mode S, legacy Conventional radars are under evaluation, part of these radars will be upgrade to Mode S Enhanced, and the upgrade solution will remain the tower components, and will focus mainly on the indoor cabinet. We have already several successful cases made, it was approved an economic way to quick achieve Mode S operation.

2.13 Considering the large number of radars in China, it is necessary to keep the efficiency of 1030/1090MHz, China has already launched the Cluster Operation Experiment this year. Now the test bench scheme has been made, the experiment environment construction is in progress.

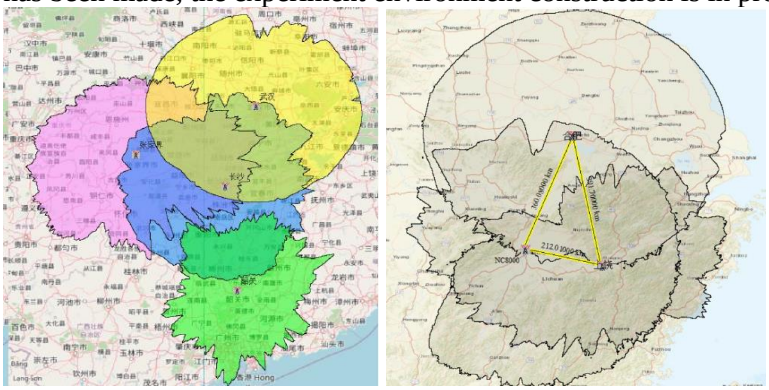

Figure 2-7 Mode S Cluster Operation Experiment Scenarios

2.14 When participating in the developing Mode S DAPs IGD, China had established a working team to focus on the Mode S DAPs activities, we are willing to continue the focus on this issue and keep tracking the update of the DAPs IGD. We encourage member States/Administrations focus on the avionic system monitoring, surveillance sensors and automation systems optimization. Any advice and comments about the DAPs IGD are welcomed to feed back to our team.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) Note the information contained in this paper, and

b) Discuss any relevant matters as appropriate.

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