International Civil Aviation Organization

SIXTH MEETING OF MODE S AND DOWNLINKED AIRCRAFT PARAMETERS WORKING GROUP (MODE S AND DAPS WG/6)

Bangkok, Thailand, 28 – 30 March 2023

Agenda Item 3: Sharing of State's implementation on Mode S and related issues in APAC region

SHARING OF GPS INTERFERENCE INVESTIGATION METHODS

(Presented by China)

SUMMARY

This paper mainly introduces methods and experience of GPS interference investigation based on ADS-B technology for civil aviation flights.

1. INTRODUCTION

1.1 Since 2018, with widely prevalent application of GPS positioning technology,the number of civil aircraft affected by GPS interference in China has increased rapidly with each passing year. Depending on the degree of interference, following results may occur on condition that airborne GPS signals be interfered:

a) aircraft dual or single GPS signal loss

b) ground proximity warning for aircraft in the approaching stage

c) accuracy and integrity decline in aircraft GPS signal, triggering aircraft to deviate from routes or from approach and departure procedures because of inaccessible accuracy requirement of RNAV

1.2 Before 2020, China investigated GPS interference by major means of contacting the interfered aircrafts to obtain the QAR data after the flight mission was over. It took at least 1-2 days to manually analyze the data, affecting timeliness of GPS interference investigation.

1.3 After 2020, with widespread application of ADS-B technology in China, interference investigation and analysis system based on ADS-B has been independently developed. The real-time data through ADS-B downlink was used to extract abnormal quality of GPS signal for statistical analysis and then form thermal map of aircraft affected by interference so as to assist technical personnel to understand GPS interference situation and preliminarily locate interference sources. The specific details of interference investigation system based on ADS-B refers to the paper, *A GPS Interference Identification Method Based on ADS-B Data* (Mode S DAPs WG/5 IP/10).

2. DISCUSSION

Interference Investigation Experience

2.1 In 2021, China has applied ADS-B data to assist in interference investigation and analysis at 32 operational sites across the country. According to statistics, 37 GPS interference investigations had completed owing to the system.

2.2 Relying on successful experience of detecting GPS interference by using ADS-B technology, the whole investigation procedures are summarized concisely as follows:

a) record GPS interference information provided by aircraft crew, including flight number, interference time, and position

b) generate the trajectory distribution map ("thermal map "for short) of flights affected by GPS interference

c) analyze the thermal map to determine general direction of the GPS jammer, and then further find the interference source in coordination with the radio monitor equipment

Interference Investigation Case

2.3 The case that approach area of the Beijing Capital Airport is affected by GPS interference is taken as an example to further explain the specific investigation methods.

Overview of the interference situation

2.4 From July to August 2022, there were roughly 12 times that flights GPS information near the capital airport were lost in the screen due to interference with GPS signals. In view of short duration of each GPS interference, the interference investigation and analysis system was not able to determine initial direction of interference source. On August 12, approach area of the Capital Airport again experienced relatively concentrated long-term interference. The detailed investigation is as follows.

Investigation Process

2.5 At 9:00 on August 12, technicians recorded the loss information of GPS signals reported by several aircraft crews from the Beijing capital Airport to an altitude of 3,000-4,000 meters.

2.6 Then, technicians immediately used the interference investigation and analysis system to select the two interfered aircraft and generate the trajectory of the aircraft interfered by GPS, as shown in Figure 1

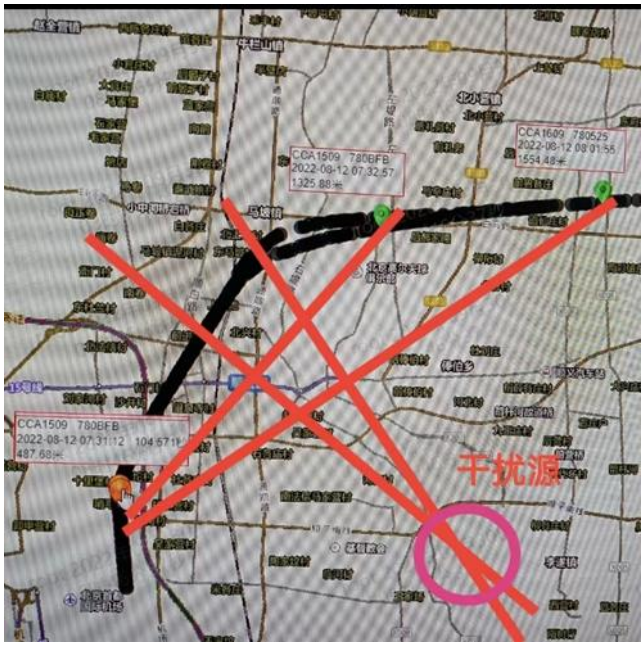

Figure 1

2.7 The orange and green dots in the figure represent the beginning and ending points of GPS interference respectively. According to the characteristics of GPS interference track and previous work experience, technicians preliminarily determine the direction of the interference source at the intersection point of geometric midperpendicular between the beginning and ending points, as shown as a circle in pink.

2.8 After judging the basic location of GPS interference source, technicians were divided into two teams, one of which continuously used the system to monitor and the other of which immediately carried portable monitoring equipment and drove to detect a construction site on Longtang Road, Shunyi District (within the pink circle area). At about 11:10, technicians found that the portable monitoring equipment detected nearby related equipment working in the frequency range of 1577MHz with a drift of ±1MHz (as shown in Figure 2), which interfered with the normal frequency range of civil aviation GPS signal (1575.42MHz±1.023MHz).

Figure 2

2.9 Finally, technicians entered the construction site at 14:00 and successfully found the GPS interference source, which was installed on one of 30 construction equipment. At that time, the

interference source was still working. After coordination with relevant departments, the GPS jammer was turned off, and the interfered aircraft displayed back to normal. It took 5 hours from the beginning of analysis to the completion of investigation.

Summary

2.10 With the help of the interference investigation and analysis system based on ADS-B to conduct GPS interference source detection, technicians are capable of paying attention to GPS interference in real time regardless of QAR data. The preliminary direction and location of interference source is access to be quickly acquired, which reduces duration of interference investigation and improves timeliness of GPS interference source detection.

3. ACTION BY THE MEETING

a) note the information contained in this paper; and

b) discuss any relevant matter as appropriate.

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