



ICAO

International Civil Aviation Organization

**THE FOURTH MEETING OF MODE S DOWNLINKED
AIRCRAFT PARAMETERS WORKING GROUP
(MODE S DAPs WG/4)**

Video Teleconference, 29 – 31 March 2021

Agenda Item 5: Review on the 1030/1090MHz occupancy in Asia Pacific

**INTRODUCTION TO THE EXPERIMENT OF 1090 MHz OCCUPANCY
AT TWO BUSY AIRPORTS IN CHINA**

(Presented by China)

SUMMARY

This information paper presents the methods and results of the 1090 MHz occupancy experiment conducted around the Beijing Capital Airport and Chengdu Airport.

1. INTRODUCTION

1.1 Transmission DAPs is relying on the 1090 MHz frequency resources. China has conducted related experiments, in order to investigate the situation of 1090 MHz occupancy, garbling, and interference around Chinese busy airports.

1.2 The experimental data of the Beijing Capital Airport were recorded in December 2020, and the data of Chengdu Airport in September 2020.

1.3 The flight volume during the two data recording periods was slightly less than that during the same period in previous years. Although the experimental results can't fully reflect the congestion on 1090 MHz around Chinese busy airports, they are still representative.

2. DISCUSSION

2.1 Subjects of the experiment

- 1090 MHz occupancy: The proportion of the sum time of multiple effective pulses duration in total duration. The effective pulse means the pulse above a certain threshold level and greater than 320 nanoseconds.
- Probability of Garbling: Probability of garbling signals and cannot be decoded replies.

2.2 Methods of the experiment

In Beijing and Chengdu, two different experimental methods were used.

2.2.1 At Beijing Capital Airport, due to lack of professional spectrum analysis equipment, the ADS-B receiver was refitted and the FPGA program was rewritten. The experimental team did not decode any replies, just calculated the pulses duration and silence duration.

2.2.2 The experimental team uses 10 milliseconds as a time unit to calculate the 1090 MHz occupancy by calculating the sum time of effective pulses duration and silence duration per unit time. When the pulse duration increases and the silence duration does not decrease significantly, which means the probability of garbling increases. See the Figures 1 and 2.

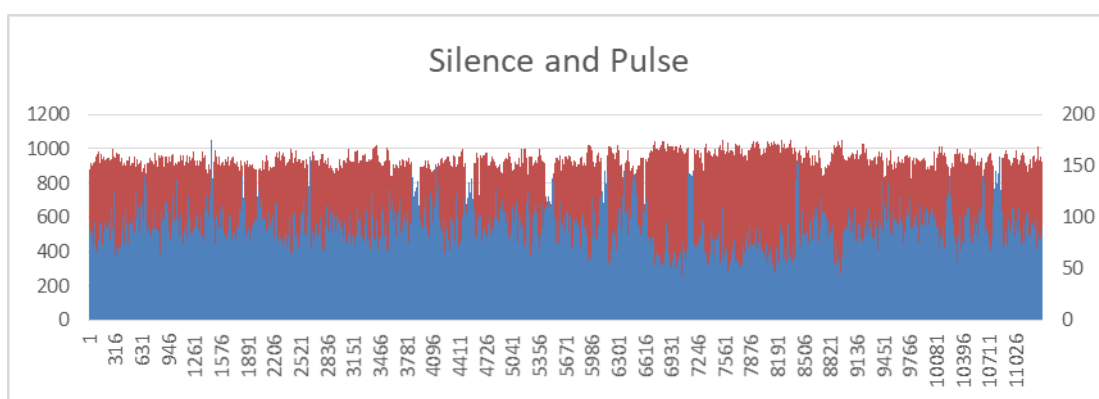


Figure 1. Duration of silence and pulse at -73dBm

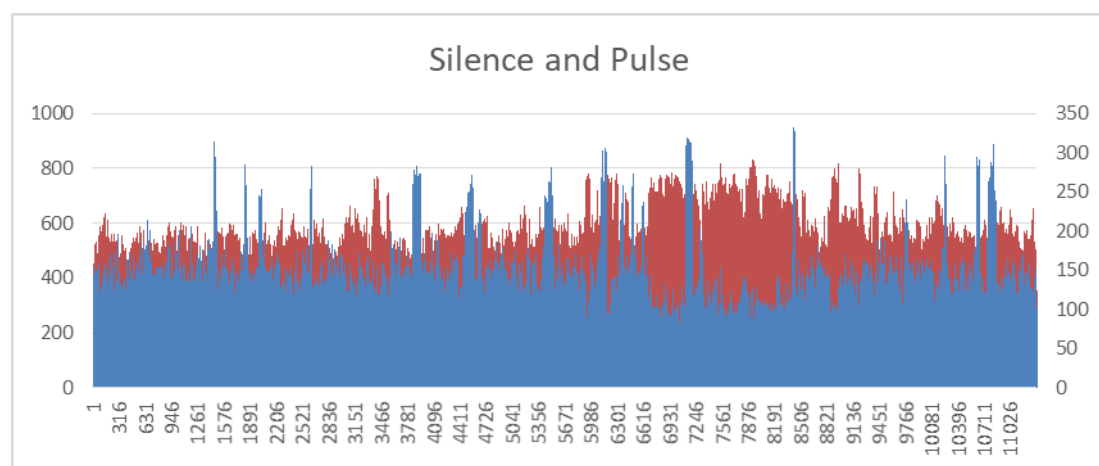


Figure 2. Duration of silence and pulse at -77dBm

Note: The horizontal axis represents time, in unit of 10 milliseconds, the left vertical axis is the number of silence within 10 milliseconds, and the right vertical axis is the number of effective pulses, both in unit of 8.533 microseconds. The red colour represents silence duration, and the blue colour represents pulse duration.

2.2.3 At Chengdu Airport, the experimental team used Rohde & Schwarz (R/S) FSVR real-time spectrum analyser and IQR recorder to build an RF recording system and record 1090 MHz signals. By reading the data file of the 1090MHz radio signal recorded by IQR, the I/Q data stream is obtained and imported into the analysis program of MATLAB, which is used to count the number of effective pulses to calculate the 1090 MHz occupancy, and the valid pulses are decoded to count the number of Mode A/C signals and the number of Mode S signals. See Figures 3 and 4.

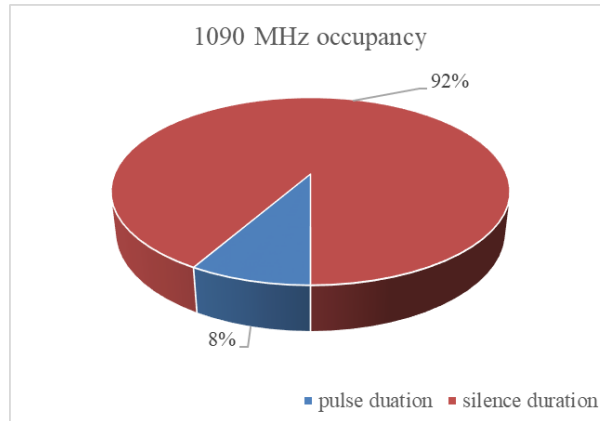


Figure 3. 1090 MHz occupancy at Chengdu Airport

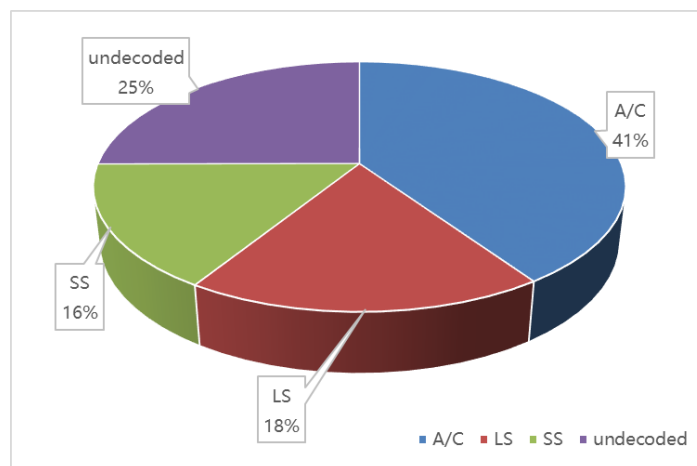


Figure 4. Ratio of replies

2.3 Results of the experiment

The experimental results in Beijing and Chengdu are basically the same.

- a) The 1090 MHz occupancy is not high, not exceeding 10%, both in two airports.
- b) The longer the receiver's distance is, the more serious the garbling is, which is consistent with the actual plot missing rate.
- c) There is an explosive increase in the pulse duration, while the silence duration does not decrease significantly when it increases, which means that the probability of garbling increases. garbling is not evenly distributed, but explosive.
- d) At Chengdu airport, in the pulse duration, the Mode A/C replies account for 41%, which are also the highest occupancy. The short Mode S replies account for 16%, the long Mode S replies account for 18%, and the rest 25% are the signals that cannot be decoded.

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e) Without increasing the overall occupancy of 1090 MHz, there are a lot of interference pulses. The main reason is that the pulse time distribution may be uneven due to the radar's distribution and their interrogation strategy. At the same time, the probability of incorrect decoding will increase when the receiver has a large coverage.

3. ACTION BY THE MEETING

The meeting is invited to:

- 1) Note the information contained in this paper; and
- 2) Discuss any relevant matter as appropriate.
