



ICAO

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 4: Mode S monitoring and analysis

THE REAL TIME MODE-S SIGNAL MONITORING WITH ASTERIX CAT. 48 DATA

(Presented by Republic of Korea)

SUMMARY

The management of 1030/1090Mhz spectrum is the one of major issue for the MSSR radar operation. This information paper presents the example of Mode-S monitoring at Incheon International airport.

1. INTRODUCTION

1.1 The utilization of the 1030/1090 MHz spectrum has gradually increased especially within the busy airport area. If no action is taken, the spectrum congestion will reach an unacceptable level that will result in loss of aeronautical surveillance service and aircraft collision avoidance system.

1.2 Serval applications are currently competing for channel time on the 1030/1090 MHz frequency based on CD(packet Collision Detection) scheme. To detect the degradation of the surveillance service, the monitoring of 1030/1090 MHz spectrum is very important. This IP presents the indirect 1030/1090 spectrum monitoring method with Asterix Cat. 48 data

2. DISCUSSION

Relevant works for the 1030/1090 MHz spectrum management

2.1 Mode-S Daps WG adds new guidance on measurement of 1030/1090 MHz at 2022. “IGD Appendix 5: Radio frequency (RF) measurement and analysis” gives the technical information about the spectrum management work. This WG recommends the necessity of monitoring the usage level and congestion situation of the 1030/1090 RF network.

2.2 At the Information Paper of year 2022 (MODE S DAPs WG/5 IP02 Management of 1030/1090Mhz utilization), Singapore presents about the establishment of SSFT(Surveillance spectrum focus team) that looks into the overall issue of 1030/1090 MHz utilization as the best practice. RPAS(Remote pilot aircraft), new ACAS version, military IFF and electronic conspicuity devices for general aviation could be the source of contributing to the spectrum load.

The contribution factor to increase the 1030/1090MHz spectrum load in Republic of Korea (Incheon airport)

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2.3 The Republic of Korea's air traffic rose 16 percent in 2022 from a year amid eased COVID-19 virus curbs but still below pre-pandemic level. As neighbour countries are lifting travel restriction, air traffic is being gradually increased. The increase of MSSR transponder operation within a narrow airspace could be contributing factor for the spectrum congestion.

2.4 At the Incheon airport, about 46 MLAT (15 TX/RX, 31 RX) stations are operational for the ground surveillance. The vehicle ADS-B transmitters and MSSR transponders operations on the airport surface are using 1030/1090 MHz spectrum also.

2.5 Korean military are in the upgrade phase for the IFF transponder (Identification friend or foe). They are testing and conducting military exercise using various new and old radars and airborne communications equipment.

2.5 Lastly, unwanted RF radiation from small devices could be a source of spectrum overwhelming. Small handheld device could produce enough RF radiation power to affect whole airport region. There was a case where Wireless CCTV device transmitted the unwanted RF radiation affecting MSSR radar operations and DME operations in the Republic of Korea.

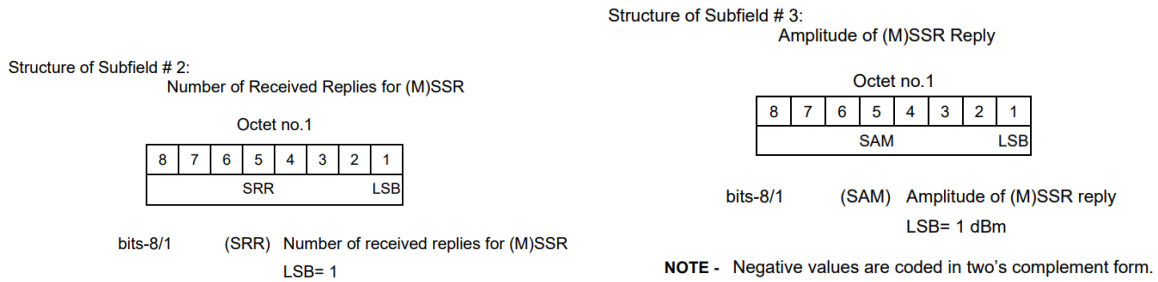
1030/1090Mhz spectrum monitoring method vs MSSR reply data monitoring

2.6 To check the frequency occupancy, the installation of an additional RF monitoring device is required. The RF monitoring device can record signal level and occupancy in time. As the alternative method, MSSR reply data monitoring could be used. The following table provides pros and cons of two method.

	1030/1090Mhz spectrum monitoring	MSSR reply data monitoring (Asterix Cat48)
Resource	Additional Antenna and RF receiver is used. (Hardware and software)	Radar analysis software is required (Software)
Pros	Initial spectrum contamination could be monitored. The level of spectrum congestion could be measured.	Better to check the health status of the MSSR reply and interrogation. Cheaply
Cons	Costly	Hard to check initial spectrum contamination.

EUROCONTROL Asterix Cat48 items for the reply monitoring]

2.7 EUROCONTROL Asterix is the standards to define the low level implementation of a data format used for exchange surveillance-related information. Asterix Cat48 defines the Monoradar target report (Edition 1.31 is the most recent version). Data Item I048/130, Radar Plot Characteristics in Asterix Cat48 has the following information that can be utilized to monitor the MSSR reply/interrogation signal. "Data Item I048/130, Radar Plot Characteristics" shows additional information on the quality of the target report.



<Figure: Cat 48, Data Item I048/130, Subfield #2, #3>

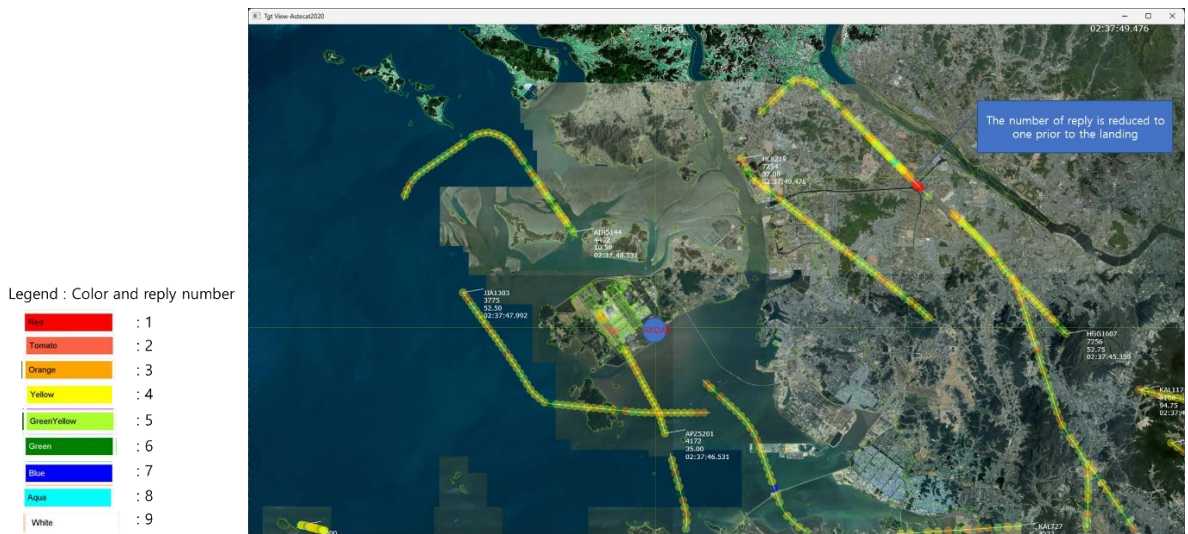
Subfield #2 has the number of received replies at MSSR receiver. A reply number can not exceed 12 for a radar configuration of 12 rpm rotation and can vary depend on the MSSR MIP configuration. 1~2 replies is too small to accurately measure the azimuth of a transponder. Maintaining proper reply number is a good check point to determine the status of MSSR communication.

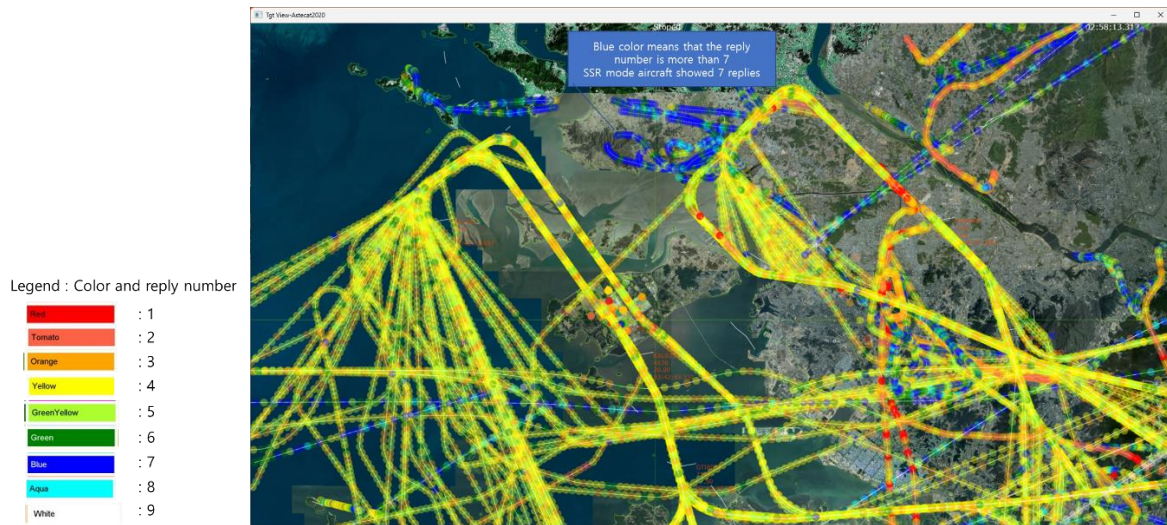
Subfield #3 contains information on the sensitivity of the MSSR receiver. If a amplitude of reply is different for each receiver channel (Ch.A & Ch.B) and changes with time, it could mean that the radar system has some problems.

Mode-S reply data monitoring at Incheon airport

2.8 The digital radar system is more sensitive than old analog device. With the recent development of RF technology, the LNA(low noise amplifier) sensitivity is increased so that it can easily overwhelmed by unwanted RF radiation. The little characteristic change in the OP amp(Operational amplifier) can affect the detection quality of the radar system. For a MSSR receiver, an incorrect receiver optimization parameter can make the MSSR false target and zig-zag detection.

2.9 For the surveillance quality monitoring, Incheon airport has developed a simple monitoring software to check the value of the Data Item I048/130. The number of received reply for MSSR radar is monitored 24 hours 7 days. Even though the Incheon airport area is one of the most RF congested area in Asia, still health status of current Mode-S communication is okay and good. But because new RF devices and unnoticed military exercises can increase the RF congestion level, Incheon airport is closely monitoring the 1030/1090 MHz spectrum. The monitoring method using MSSR reply data is better to make the Fail or Okay decision for a MSSR operation.





<Figure : The monitoring of MSSR reply number >

Discussion

2.10 The 1030/1090 MHz spectrum monitoring activity among ICAO member states is recommended by Mode-S Daps WG. Republic of Korea is willing to share the research results and relevant software tool with other states to protect the 1030/1090 MHz frequency resource.

3. ACTION BY THE MEETING

- a) note the information contained in this paper; and
- b) discuss any relevant matter as appropriate
