*International Civil Aviation Organization*

**MIDANPIRG Communication, Navigation and Surveillance Sub-Group**

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**Agenda Item 5: Frequency Management Working Group (FM WG/4) Main Matters**

# FREQUENCY SPECTRUM CONGESTION FOR ATC TWR SERVICES

*(Presented by Saudi Arabia)*

**SUMMARY**

This paper discusses the issue of frequency spectrum congestion affecting the Aerodrome Surface Control (ASC) and Tower (TWR) services at King Abdulaziz International Airport in Jeddah (OEJN). The congestion is primarily caused by increased use for available frequencies, especially during the approach and landing phases of flight operations. The paper also suggests a technical solution and provides recommendations aimed at mitigating the impact of this issue.

Action by the meeting is in paragraph 4 of this WP.

**REFERENCES**

- ICAO Handbook on Radio Frequency Spectrum Requirements for Civil Aviation, Doc. 9718. 2nd Edition, 2022
- ICAO Annex 10

## 1. INTRODUCTION

1.1 Due to the increasing volume of air traffic and introduction of operational improvements simultaneous operations on parallel or near-parallel instrument runways (SOIR), there is a growing need to enhance operational efficiency—particularly in the Terminal Manoeuvring Area (TMA) of King Abdulaziz International Airport in Jeddah (OEJD). One key area of focus is the improvement of take-off and landing movement rates. This operational demand has led to significant congestion in the frequency spectrum allocated for ATS communications.

1.2 To address this challenge, it is essential to develop and implement effective frequency spectrum management solutions. These solutions should be fully aligned with the regulatory frameworks established by the International Civil Aviation Organization (ICAO) and the General Authority of Civil Aviation (GACA) to ensure safety, compliance, and interoperability.

1.3 The following key challenges have been identified as critical factors contributing to frequency spectrum congestion within the Terminal Manoeuvring Area (TMA):

A- High Communication Density:
Intensive use of communication channels for Aerodrome Surface Control (ASC) and Tower (TWR) operations, especially during peak traffic periods, leads to saturation of available frequencies generating risks of missing or queuing urgent communications.

B- Frequency Overlap:
Multiple operational entities—including civil aviation, military operations, and emergency services—often operate within overlapping frequency bands, increasing the risk of interference increasing the coordination complexity.

C- Limited Availability of aeronautical -Designated Bands:
The finite allocation of spectrum specifically designated for aviation use restricts flexibility in frequency planning and assignment, particularly in high traffic areas.

## 2. DISCUSSION

2.1 When transmitters and receivers are positioned in proximity, there is a significant risk of interference. This interference can result in the generation of unwanted signals that degrade system performance and may obstruct the reception of intended communications. Such conditions are particularly critical in high-density operational environments like airport TMAs, where multiple systems operate simultaneously within limited spectrum bands.

2.2 The Sources of Interference can be summarized as follows:

A- Receiver Cross-Modulation: This occurs when the modulation of a strong off-channel signal is unintentionally transferred onto a weaker, desired on-channel signal. The result is distortion or loss of clarity in the intended communication, which can compromise operational safety and efficiency.

B- Inter-Modulation Products Generated by Transmitters and Receivers: These are unwanted frequencies created when multiple signals mix within the output stages of transmitters or the input stages of receivers. Such inter-modulation products may fall within the same frequency band as a desired signal, leading to direct interference and degraded the overall system performance.

2.3 The straight-forward and simplest mitigations and solutions may include:

A- Increase Antenna Separation: Reducing interference can be achieved by physically increasing the distance between transmitting and receiving antennas to improve isolation and overlap.

B- Use RF Filters and Isolators: When spacing is limited, additional isolation can be provided by integrating RF filters and isolators into the antenna circuits.

2.4 Due to cost implications, Saudi Air Navigation Services (SANS) adopted the second mitigation action in alignment with the findings of the Park Air Spectrum Study. As part of this approach, newly added communication channels have been designed with additional protective measures to minimize interference and ensure operational reliability. These protections include:

1- Improved frequency spacing to reduce overlap and inter-modulation risks: by using the existing SANS FM Database and ICAO Frequency Finder Software.

2- Enhanced filtering and shielding in equipment design: By adding three different types of filters:

a. Double Cavity Filters.

b. Band Reject Filter (Notch Filter)

c. Crystal Filter.

Although the use of multiple filters can lead to power loss and increase the distortion level, this approach was deemed the optimal and best solution for introducing a new frequency within the Jeddah ASC / TWR services. The decision aligns with the recommendations of the Park Air Spectrum Study, prioritizing interference protection and operational reliability over minor performance trade-offs. In addition to the above measures, this practice was adopted for the first time at the Radio Transmitter / Receiver (RTR) sites at King Abdulaziz International Airport (OEJN). While it significantly enhanced interference protection, it also led to increased costs and most connectivity complexity due to the additional infrastructure and integration requirements.

2.5 Calculation of Signal propagation Path Loss: The Egli Model was used to measure the path loss, which can be estimated using the free-space propagation, based on the distance between transmitting and receiving antennas. The ITU formula is:

$$\text{Path Loss (dB)} = 32.44 + 20 \cdot \log(F) + 20 \cdot \log(D)$$

Where:

F = frequency in MHz

D = distance in kilometres

This calculation provides a minimum path loss value, offering a safety margin for system design and helping ensure reliable communication performance.

2.6 The following ICAO Annex 10 Vol II recommendation has been considered “After due allowance has been made for feeder loss and antenna polar diagram variations, the sensitivity of the receiving function shall be such as to provide on a high percentage of occasions an audio output signal with a wanted/unwanted ratio of 15 dB, with a 50% amplitude modulated radio signal, having a field strength of 20 μV/m or more.”

## 3. CONCLUSION:

3.1 According to the ICAO FM document, the newly introduced channels within the ASC bands suffer from a scarcity of available frequencies. As a result, three types of filters (Double Cavity filter, Notch filter and crystal filters) were added to mitigate potential interference, whether generated by inter-modulation or cross-modulation. While these filters help reduce interference, they have also led to increased costs, system complexity, and a rise in noise levels.

3.2 This situation highlights the growing need for reviewing spectrum frequencies management and allocation for the tower services to ensure continued system performance, address future technical challenges and support the traffic growth.

## 4. ACTION BY THE MEETING:

4.1 The meeting is invited to:

a) take note of the information provided in this WP;

b) discuss the possibility of redistribution of AM(R)S Band (117.975 – 137 MHz) for Better Balance in Tower and Ground Communications;

c) review the current MID spectrum allocation published under the ICAO Handbook on Radio Frequency Spectrum Requirements for Civil Aviation;

d) invite States to conduct Theoretical Simulation Studies before implementing any frequency additions, perform simulation studies to avoid a potential harmful interference and ensure compatibility; and

e) invite states to support the ICAO position to maintain the frequency allocation for the VHF band during WRC-27.

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