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PROTECTION OF RADIO ALTIMETER SYSTEMS FROM THE UNDESIRABLE IMPACT OF 5G TELECOMMUNICATION NETWORKS DEPLOYED AROUND THE AERODROMES AND HELIPORTS

(Presented by Saudi Arabia)

EXECUTIVE SUMMARY

This paper describes the safeguarding measures and protection criteria adopted by Saudi Arabia to minimize the potential risk of interference that may be caused by 5G telecommunication networks on radio altimeters. It also provides information on the requirements adopted by the Communications, Space, and Technology Commission for the siting and setting of 5G base stations around aerodromes and heliports to protect radio altimeters during aircraft and helicopter operations.

In the attachments A and B, the paper provides details on the protection areas adopted around the aerodromes and heliports, the maximum Equivalent Isotropic Radiated Power (EIRP), and the maximum antenna height above ground level that will be authorized within these areas.

<i>Strategic Goals:</i>	This working paper relates to <i>Every Flight is Safe and Secure</i> .
<i>Financial implications:</i>	Activities to be undertaken within existing budgetary allocations
<i>References:</i>	Doc 10184, <i>Assembly Resolutions in Force (as of 7 October 2022)</i> State letter SP 74/1-21/22 dated 25 March 2021 MID Doc 015 - Guidance on safeguarding measures to protect Radio Altimeter from potential harmful interference from Cellular 5G Communications

1. INTRODUCTION

1.1 The increasing deployment of 5G telecommunication networks—particularly those operating in frequency bands adjacent to the 4.2–4.4 GHz band used by radio altimeters—has raised safety concerns within the international aviation community. The potential risks can be summarized as follows:

- a) erroneous altimeter readings that may result in false altitude data during approach phases;
- b) potential Loss of altimeter functionality, which results in complete or intermittent signal loss, affecting critical systems such as autopilot, ground proximity warning systems (GPWS), and enhanced vision systems (EVS);
- c) increased risks of go-arounds, delays, or cancellations due to degraded safety margins in affected airspace.

1.2 In response to the safety concerns, ICAO circulated State letter (Ref: SP 74/1-21/22 dated 25 March 2021), informing all Contracting States that it had received studies from several States and organizations regarding the potential risk of interference caused by 5G telecommunication networks on radio altimeters. These studies generally conclude that some radio altimeters will be impacted if high-power cellular systems are deployed near the frequency band used by radio altimeters. Several States have already taken temporary technical, regulatory, and operational mitigations on the deployment of new 5G systems to protect radio altimeter operations while more permanent solutions are being devised.

1.3 In alignment with this global concern, Saudi Arabia, through the Saudi General Authority of Civil Aviation (GACA) and in coordination with the Communications, Space, and Technology Commission (CST), conducted a detailed technical and regulatory assessment. The findings led to the development of national safeguarding measures, coordination mechanisms, and reporting procedures aimed at ensuring the continued safe operation of aircraft in the presence of 5G networks.

2. 5G C-BAND NETWORK DEPLOYMENT IN SAUDI ARABIA

2.1 GACA and CST Coordination

2.1.1 To address the potential risks of 5G telecommunications networks interfering with Radio Altimeter systems, GACA initiated a collaborative effort with the Communications, Space, and Technology Commission (CST). Both parties agreed that there was a need to develop a comprehensive study to assess and mitigate these risks. The study would:

- a) define criteria for safe 5G deployment near aerodromes, ensuring compliance with aviation safety standards;
- b) propose exclusion and protection zones around airports and heliports;
- c) establish reporting and resolution mechanisms for interference incidents; and

- d) implement an escalation process to ensure timely resolution of any detected interference events.

2.2 Spectrum Advisory Group (SAG)

2.2.1 To assess the above risks and define measures to protect Radio Altimeter systems from the potential harmful interference from 5G telecommunications networks”, CST in consultation with GACA established the Spectrum Advisory Group (SAG) composed of experts and specialists from CST and GACA. This group was tasked to develop a detailed technical study providing recommendations on suitable protection criteria to avoid any interference on radio altimeters that may be caused by the 5G telecommunication networks. The study covered:

- a) experiments, field measurements, and a follow-up on regional and global developments on 5G telecommunications networks to gather sufficient data and information supporting the definition of protection criteria; and
- b) the approach used for the analysis of potential interferences, conclusions, and recommendations to adopt specific protection criteria. This approach comprises two main parts covering out-of-band 3.7 - 4.0 GHz and in-band 4.0 – 4.2 GHz frequencies.

2.2.2 Moreover, the study also included radio altimeters installed in fixed-wing aircraft and rotary aircraft to ensure that it covered all types of aircraft operating in Saudi Arabia.

2.2.3 The study establishes the protection criteria that must be applied to protect the Radio Altimeter from 5G telecommunication networks operating in the band 3.7-4.0 GHz and the band 4.0-4.2 GHz. These criteria are based on the aircraft's altitude during the approach phase and landing at aerodromes or heliports, to reduce the probability of interference during the deployment of 5G base stations at aerodromes and heliports and within their vicinity.

2.2.4 The protection areas that result from the criteria generated by the study are provided in attachment A and B to this paper with details on their description.

2.2.5 Moreover, GACA and CST adopted reporting processes and procedures to collect information on any interference or abnormal indication on radio altimeters observed in-flight by aircraft and helicopter operators. Since the adoption of these processes and procedures, there have been no reports on interference or abnormal indications on radio altimeters. GACA and CST are maintaining daily oversight to capture any concerns related to 5G.

3. CONCLUSION

3.1 In Saudi Arabia, the wireless 5G broadband infrastructure is designed to enhance speed, reduce latency, and improve the adaptability of wireless telecommunications. CST has authorized the use of the 3.8 -4.0 GHz frequency band for International Mobile Telecommunications (IMT) to facilitate 5G broadband services.

3.2 Additionally, CST has authorized the use of the 4.0-4.2 GHz frequency band to support private 5G networks, which are designed for specific organizational needs with a limited licensing

framework. This model allows multiple users to enhance security, reliability, and low latency under specific technical conditions.

3.3 The protection criteria adopted by Saudi Arabia to protect the Radio Altimeter from 5G telecommunication networks operating in the band 3.7-4.0 GHz and the band 4.0-4.2 GHz are based on a comprehensive technical study. These criteria are based on the aircraft's altitude during the approach phase and landing at aerodromes or heliports, to reduce the probability of interference during the deployment of 5G base stations at aerodromes and heliports and within their vicinity.

3.4 The Assembly is invited to take note of the information provided in this paper and encourage States to share information, through ICAO, on their safeguarding measures to protect radio altimeters from potential harmful Interference around Aerodromes and Heliports that may be caused by 5G Base Stations Operating in the Band 3.7-4.2 GHz.

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APPENDIX A

SAFEGUARDING MEASURES ADOPTED BY CST TO PROTECT RADIO ALTIMETERS FROM POTENTIAL HARMFUL INTERFERENCE AT AERODROMES AND HELIPORTS FOR BASE STATIONS OPERATING IN THE BAND 3.7-4.0 GHZ.

This section summarizes the protection criteria that must be applied to protect the Radio Altimeter from 5G telecommunication networks operating in the band 3.7-4.0 GHz. These criteria are based on the aircraft's altitude during the approach phase and landing, to reduce the probability of interference during the deployment of 5G base stations at aerodromes and within their vicinity.

1. Fixed-wing and rotary-wing aircraft measures are necessary to protect aerodromes and heliports from 5G harmful interference:

The 5G base stations deployment at an aerodrome or heliport or within their vicinity should comply with the following conditions:

1.1 The maximum Equivalent Isotropic Radiated Power (EIRP) must be -45 dBm/MHz with an antenna height not exceeding 40 m above ground level. The antenna radiation pattern modes that point away from the runway with emitted energy below the horizon can greatly reduce the probability of interference power exceeding receiver blocking specification for worst-case Radio Altimeter specification.

1.2 The installation must consider the following zoning:

- a) **Precautionary protection criteria for fixed-wing aircraft:** Exclusion and protection zones are proposed to mitigate interference at an aerodrome (as shown in Figure 1). The 5G base stations must not be permitted to operate inside the exclusion zones defined as a circular shape with a radius of 2000 meters from the runway end; and

Protection Zones: recommended for all 5G base stations with a circular shape with a radius between 2000 meters and 6000 meters from the runway end, and a specific technical configuration to limit the maximum radiated power and antenna tilt angle below the horizon.

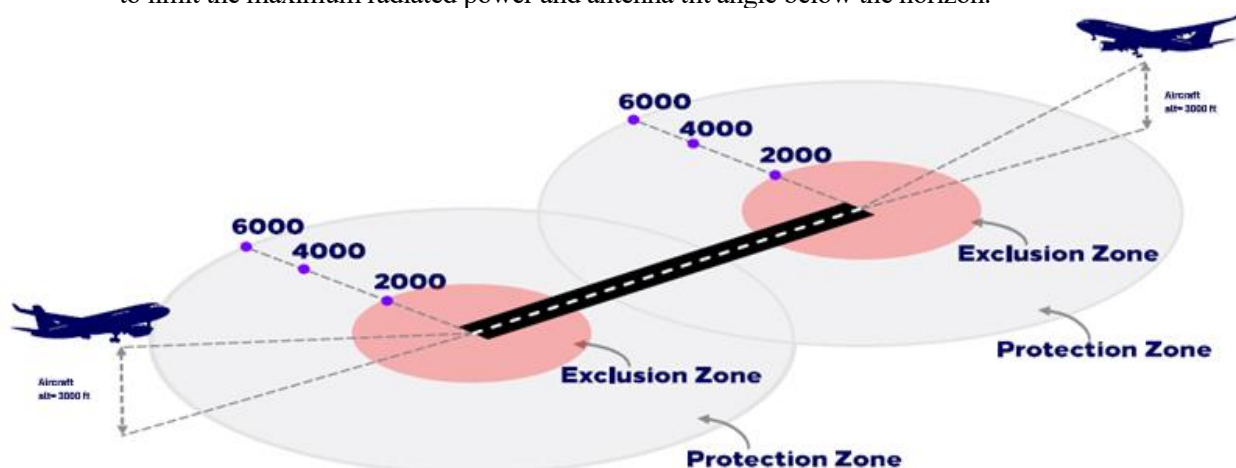


Figure 1. Exclusions zones have a circular shape centered on the Runway end with a radius of 2000m and the protection areas are circular with a radius between 2000m to 6000m

Table1

EIRP	Antenna Height
Pmax -45 dBm/MHz	40 m (AGL)

- b) **Precautionary protection criteria for rotary wing aircraft:** The exclusion and protection zones aim to mitigate interference at a heliport (as shown in Figure 2). The 5G base stations must not be permitted to operate inside the exclusion zones defined as a circular shape centered the heliport with 2000 meters; and

Protection Zones: recommended for all 5G base stations with a circular shape with a radius of 2000 meters up to 6000 meters from the runway end, and a specific technical configuration to limit the maximum radiated power and antenna tilt angle below the horizon.

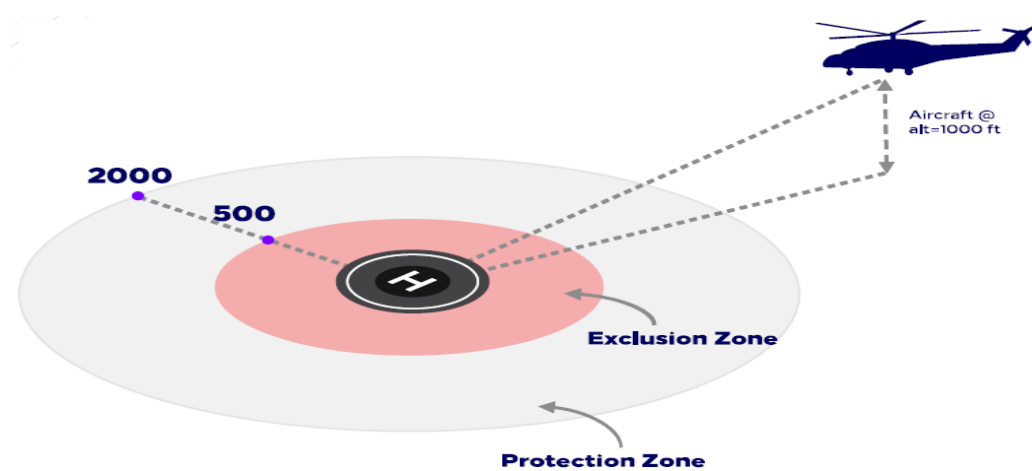


Figure2: Exclusive zones have a circular shape with a radius of 500m and the protection area is circular with a radius between 500 m and 6000m

Table 2

EIRP	Antenna Height
Pmax -45 dBm/MHz	40 m (AGL)

APPENDIX B

SAFEGUARDING MEASURES ADOPTED BY CST TO PROTECT RADIO ALTIMETERS FROM POTENTIAL HARMFUL INTERFERENCE AT AERODROMES AND HELIPORTS FOR BASE STATIONS OPERATING IN THE BAND 4.0-4.2 GHZ

This section summarizes the protection criteria that should be applied to protect the Radio Altimeter from 5G telecommunication networks operating in the band 4.0-4.2 GHz. These criteria are based on the aircraft's altitude during the approach phase and landing, to reduce the probability of interference during the deployment of 5G base stations at aerodromes and within its vicinity.

1. Fixed-wing and rotary-wing aircraft measures are necessary to protect aerodromes and heliports from 5G harmful interference:

The 5G base stations deployment at an aerodrome and a heliport or within their vicinity should comply with the following conditions:

- 1.1 The Maximum Equivalent Isotropic Radiated Power (EIRP) must be -29 dBm/MHz with an antenna height not exceeding (40 m) above ground level. The antenna radiation pattern modes that point away from the runway with emitted energy below the horizon can greatly reduce the probability of interference power exceeding receiver blocking specification for worst-case Radio Altimeter specification.
- 1.2 The installation must consider the following zoning:
 - a) **Precautionary protection criteria for fixed-wing aircraft:** Exclusion zones are proposed to mitigate interference at an aerodrome (as shown in figure1). The 5G base stations must not be permitted to operate inside the exclusion zones defined as a circular shape with a radius of 1500 meters from the runway end.

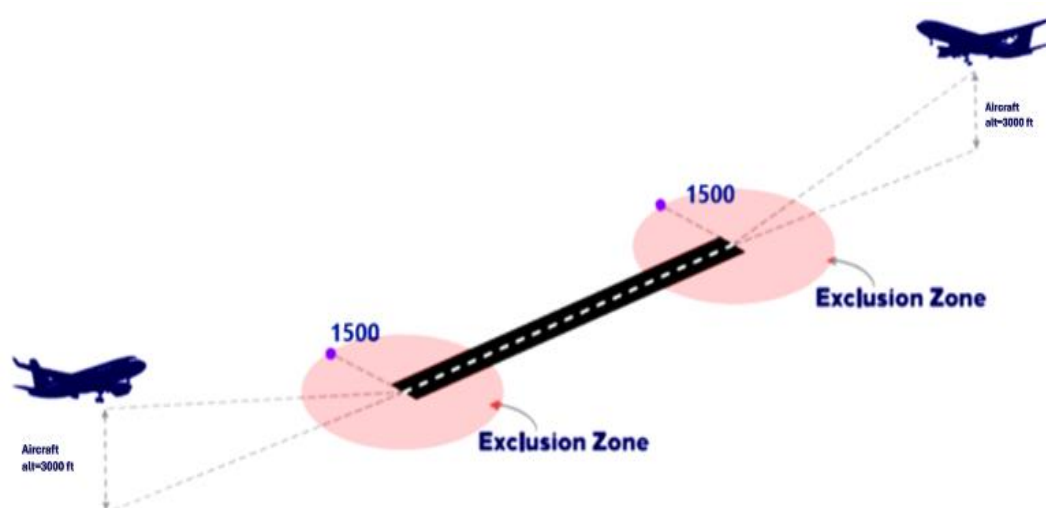


Figure 3: Exclusive zones have a circular shape with a radius of 1500m

Table 3

Maximum Emitted Power (EIRP)	Antenna Height
Pmax -29 dBm/MHz	40 m (AGL)

- b) **Precautionary protection criteria for rotary-wing aircraft:** The exclusion zones aim to mitigate interference at a heliport (as shown in Figure 2). The 5G base stations must not be permitted to operate inside the exclusion zones defined as a circular shape centered on the heliport with 1500 meters.

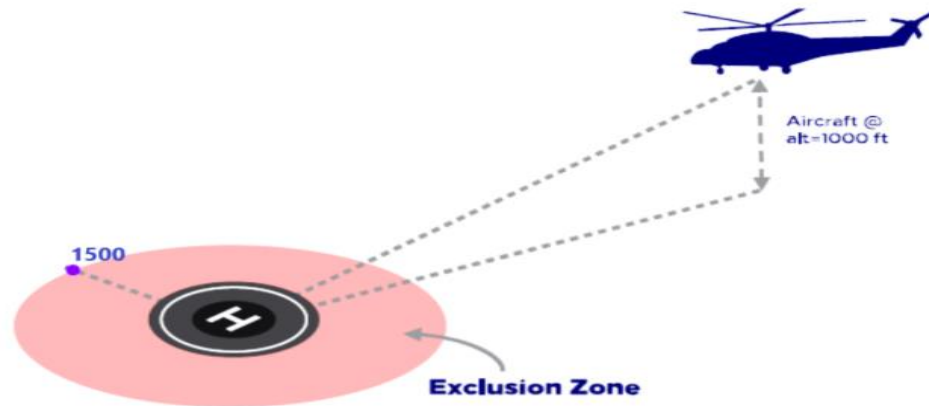


Figure 4: Exclusive zones have a circular shape with a radius of 1500m

Table2

Maximum Emitted Power (EIRP)	Antenna Height
Pmax -29 dBm/MHz	40 m (AGL)

- c) **Protection zones for low-power licensing:** There is no need to impose exclusive zones or protection zones for low-power licensing, provided that transmitting stations are operated with Maximum Equivalent Isotropic Radiated Power (EIRP) of -11 dBm/MHz with an antenna height not exceeding (40 m) above ground level with antenna radiation pattern modes that point away from the runway with emitted energy below the horizon.

Table 3

Maximum Emitted Power (EIRP)	Antenna Height
Pmax -11 dBm/MHz	40 m (AGL)

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