Protection of Radio Altimeter Systems from Potential Interference from 5G C-band Communications Networks

EUR/NAT and MID Preparatory Workshop to ITU WRC-27
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Agenda Item 4:Radio Altimeter and 5G issues

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Saudi Arabia

Introduction: Radio Altimeters Critical Aeronautical System (1/4)

> **Radio Altimeters are the only sensor onboard an aircraft that directly measures height above ground level (AGL) during critical phases of the flight.**

Radio Altimeters transmit radio frequency signals (4.2-4.4 GHz) from the aircraft to the ground and measure the time for the signal to return.

Unlike barometric or GPS references, which measure altitude above sea level, radio altimeters provide precise and accurate terrain clearance information.

RA is supporting the following critical onboard features:

- Height monitoring during Low-visibility approaches and landings
- Ground Proximity Warning Systems (GPWS)
- Terrain Awareness and Warning Systems (TAWS)
- Autopilot decision height alerts
- Enhanced vision systems

Introduction: Radio Altimeter and 5G potential interference (2/4)

The increasing deployment of 5G telecommunication networks—particularly those operating in the C-Band frequencies adjacent to the 4.2–4.4 GHz band used by radio altimeters— has raised safety concerns among the international aviation community. In response to these concerns, ICAO issued State Letter SP 74/1-21/22, alerting States to the potential for harmful interference.

In response to this global concern, the Kingdom of Saudi Arabia, through the General Authority of Civil Aviation (GACA) and in coordination with the Communications, Space, and Technology Commission (CST) – Telecom Authority, conducted a comprehensive technical and regulatory assessment before 5G deployment. The results led to the development of national safeguarding measures, coordination mechanisms, and reporting procedures aiming at ensuring the safeguarding and continued safe aircraft operations of aircraft with the deployment of 5G networks.

Technical Background: Potential of 5G Interference (3/4)

The proximity of 5G C-band frequencies to radio altimeter operating bands creates potential for harmful interference.

5G telecommunications networks in Saudi Arabia operate in the following bands:

- 3.4–3.8 GHz band for. (public 5G network services)
- 3.8–4.0 GHz band for (public 5G networks services) under specific protection measures, since 2025.
- 4.0 -4.2 GHz (private 5G networks) planned for future release through Light licensing with Low-medium Power (EIRP).

Radio altimeters operate in:

- 4.2 - 4.4 GHz

Potential Safety Risks that may be caused by the interferences:

- Erroneous altimeter readings during critical flight phases
- Complete or intermittent signal loss affecting autopilot, GPWS, and EVS
- Increased go-arounds, delays, or flight cancellations

Saudi Arabia updates on Radio Altimeter and 5G issues

In response to the ICAO State Letter (SP 74/1-21/22), the Kingdom of Saudi Arabia initiated a proactive collaboration between aviation and telecommunications regulatory authorities to safeguard the safety of aircraft operations while enabling technological progress.

Joint collaborative work GACA – CST Framework:

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) – Telecom Authority. Both parties agreed that there was a need to develop a comprehensive study to assess and mitigate these risks. The study would:

- Define criteria for safe 5G deployment near aerodromes and heliports, ensuring compliance with aviation safety standards;
- Propose exclusion and protection zones around airports and heliports;
- Establish reporting and resolution mechanisms for interference incidents and occurrences;
- Implement an escalation process to ensure the timely resolution of any detected interference events.

Spectrum Advisory Group (SAG)

To assess potential risks and define the necessary measures to protect radio altimeter systems from harmful interference caused by 5G/IMT networks, the Communications, Space and Technology Commission (CST), in coordination with the General Authority of Civil Aviation (GACA), engaged the Spectrum Advisory Group (SAG). This group, composed of academic experts from various Saudi universities, operates under the National Spectrum Coordination Committee at CST. The group is tasked with studying national spectrum-related matters and providing the necessary recommendations.

The study covered both fixed-wing and rotary-wing aircraft to ensure comprehensive protection of all aircraft operations in the Kingdom.

Safeguarding Measures to Protect Radio Altimeters from Potential Harmful Interference (1/3)

Protection criteria for the Radio Altimeter based on a comprehensive technical study by the Spectrum Advisory Group (SAG)

The protection criteria adopted to protect the Radio Altimeter from 5G telecommunication networks operating in the bands 3.8- 4.0 GHz and 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 heliports and within their vicinity.

3.8 - 4.0 GHz Band: Adjacent to the radio altimeter band, requiring stricter protection measures.

Parameter	Requirement
Maximum EIRP	45 dBm/MHz
Maximum Antenna Height	40m above ground level
Exclusion Zone (Fixed-wing)	2000m radius from runway end
Protection Zone (Fixed-wing)	2000-6000m radius from runway end (threshold)
Exclusion Zone (Rotary-wing)	500m radius from heliport center
Protection Zone (Rotary-wing)	500-2000m radius from heliport center

4.0 - 4.2 GHz Band: Directly adjacent to the radio altimeter band, requiring stricter protection measures.

Parameter	Requirement
Maximum EIRP	29 dBm/MHz
Maximum Antenna Height	40m above ground level
Exclusion Zone (Fixed-wing)	1500m radius from runway end
Exclusion Zone (Rotary-wing)	1500m radius from heliport center

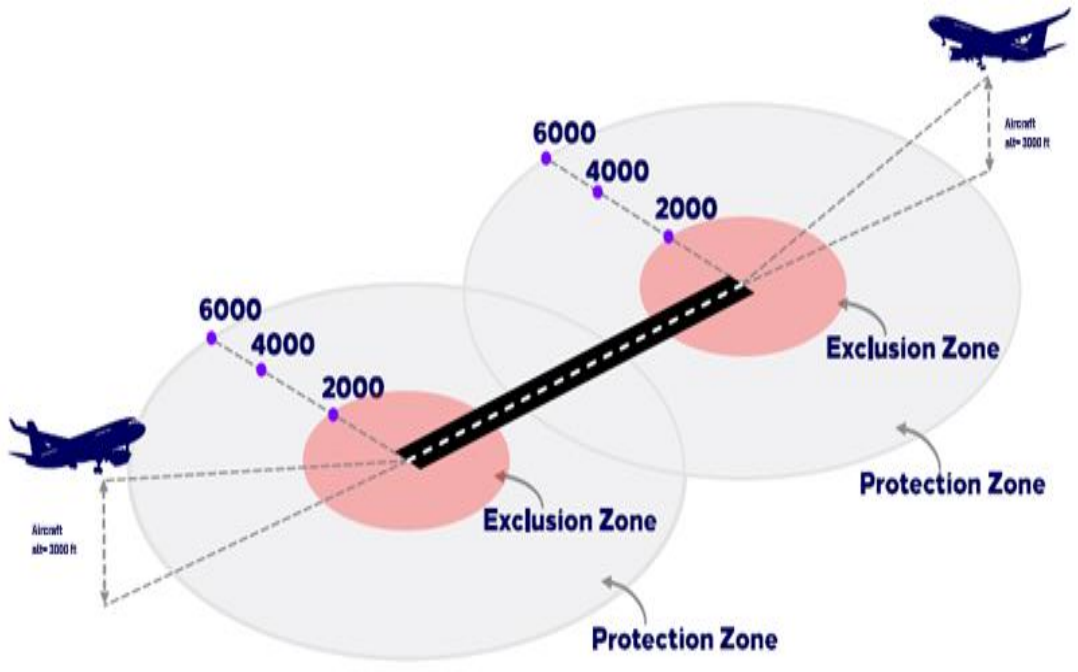
Safeguarding Measures to Protect Radio Altimeters from Potential Harmful Interference (2/3)

Protection criteria of the Radio Altimeter based on a comprehensive technical study by the Spectrum Advisory Group (SAG)

Fixed-wing aircraft:

Exclusion zones: 2000 meters radius from the runway end

Protection zones: 2000-6000m radius from runway end

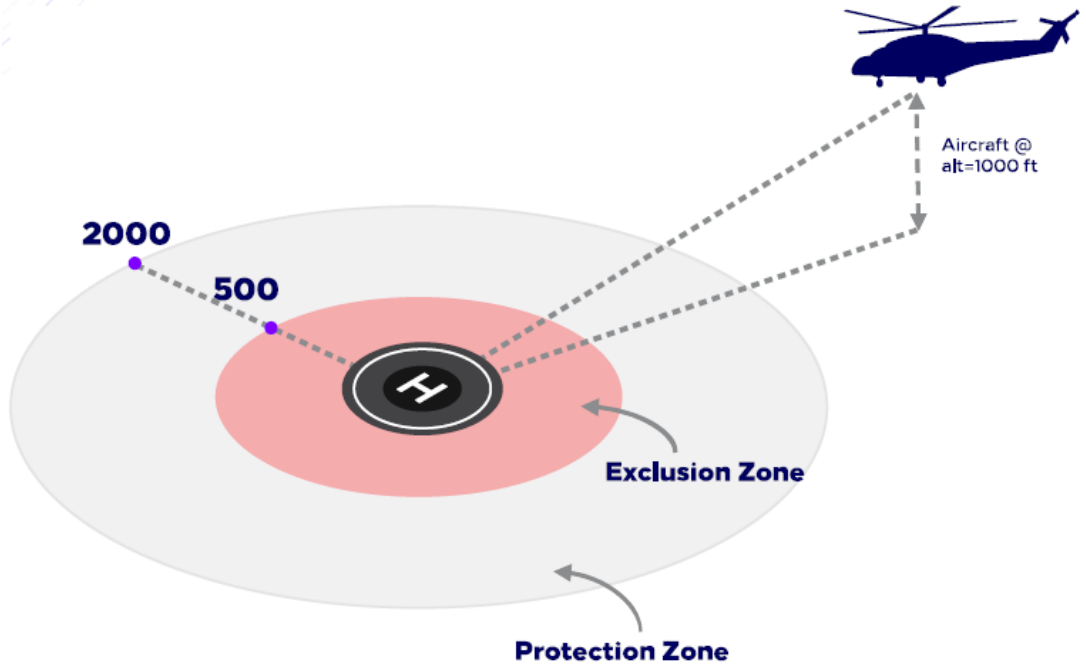


Exclusion and Protection zones for fixed-wing aircraft at the aerodromes

Rotary-wing aircraft:

Exclusion zones: 500m radius circular centered the heliport with

Protection zones: 500 - 2000m radius from centered heliport



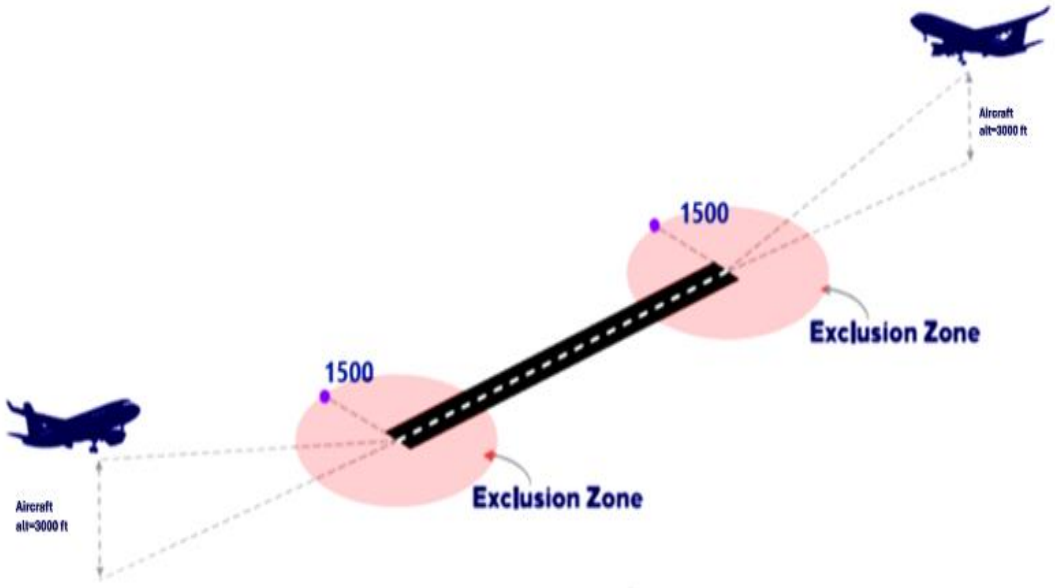
Exclusion and Protection zones for the heliport to protect the rotary-wing aircraft

Safeguarding Measures to Protect Radio Altimeters from Potential Harmful Interference (3/3)

Low-Power Licensing Exception:
For low-power operations with EIRP of 11 dBm/MHz, no exclusion zones are required if antenna patterns point below the horizon.

Fixed-wing aircraft:

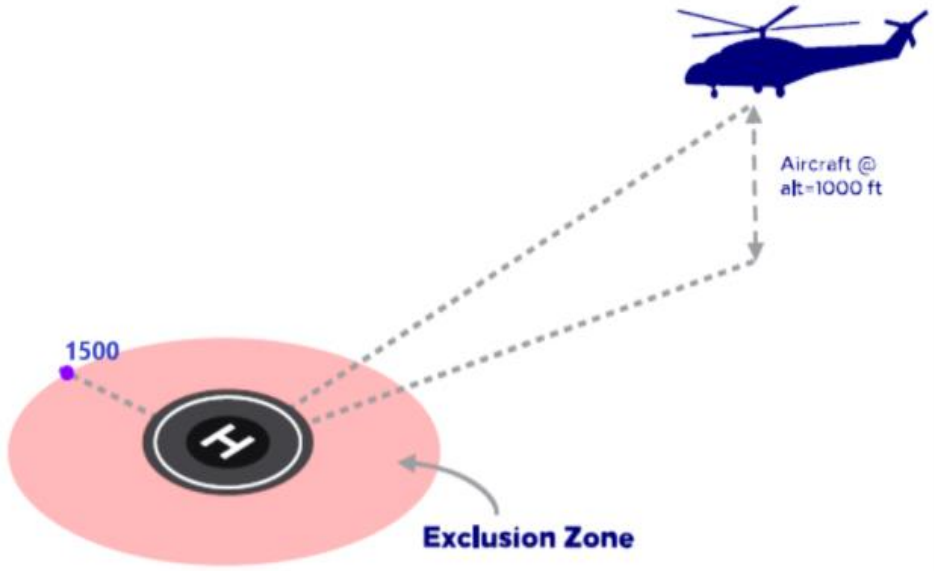
Exclusion zones: 1500 meters radius from the runway end



Exclusion zones for fixed-wing aircraft at the aerodromes

Rotary wing aircraft:

Exclusion zones: 500 meters radius circular centered the heliport with



Exclusion zones for the heliport to protect the rotary-wing aircraft

Summary of the Saudi Arabia Framework

Approach to 5G/Radio Altimeter Coexistence

1. Collaborative Framework:

Joint GACA and CST initiative with the Spectrum Advisory Group (SAG) to develop a detailed technical study providing recommendations on suitable protection criteria to avoid any interference on Radio Altimeters

2. Evidence-Based Technical Study:

Comprehensive analysis including the measurements, experiments, and international best practices

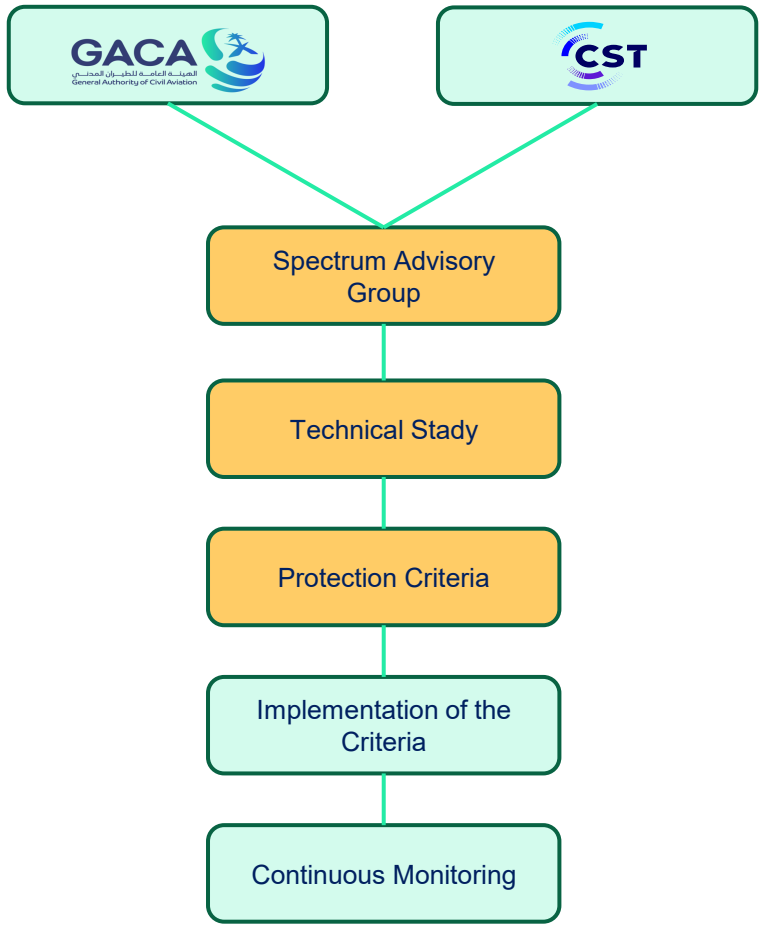
3. Tailored Protection Criteria:

Band-specific and aircraft-specific safeguards with exclusion zones, power limits, and antenna configurations

4. Robust Implementation Framework:

Clear reporting procedures, rapid response commitments, and defined escalation paths between GACA and CST.

GACA & CST Collaborative Framework



WRC-27 Agenda Item (1.7) – IMT/Radio altimeter & ICAO (4/4)

ICAO State Letter SP 74/1-21/22 (March 2021) alerted States to the potential harmful interference to radio altimeters from 5G networks.

Several States have implemented temporary technical, regulatory, and operational mitigations while permanent solutions are being developed.

ICAO is particularly concerned about the potential impacts of IMT identification in the band adjacent to the aeronautical systems in the 4.2 – 4.4 GHz frequency band.

- The scop of Agenda item 1.7 is to consider studies on sharing and compatibility and develop technical conditions for the use of International Mobile Telecommunications (IMT) in the frequency bands **4 400-4 800 MHz**, **7 125-8 400 MHz** (or parts thereof), and **14.8-15.35 GHz** taking into account existing primary services operating in these, and adjacent, frequency bands, in accordance with Resolution 256 (WRC-23).

WRC-27 Agenda Item 1.7 Focus:

To consider studies on sharing and compatibility for IMT in:

4.4-4.8 GHz (adjacent to radio altimeter band)

7.125-8.4 GHz

14.8-15.35 GHz

Resolution 256 (WRC-23) requires that these studies ensure protection of existing primary services without imposing additional regulatory or technical constraints.

GACA
الهيئة العامة للطيران المدني
General Authority of Civil Aviation

Questions?

Thank You

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