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FRENCH'S MITIGATION MEASURE TO PROTECT RADIO ALTIMETERS FROM POTENTIAL INTERFERENCE WITH 5G DEPLOYED IN THE 3.4-.8GHZ FREQUENCY BAND.

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Agenda

- **Mitigation Measures in France**
    - Background
    - What assumptions were made?
        - Definition of the protection zones
    - Calculation method

- **5G antenna pattern**
    - Non AAS antenna
    - AAS antenna (Advanced Antenna Systems)

Mitigation Measures in France

Mitigation Measures in France

• Background

- October 2020 : RTCA published Report SC-239 on the “Assessment of C-Band Mobile Telecommunications Interference Impact on Low Range Radar Altimeter Operations” highlighted the following issues with the operation of mobile/fixed communications network using 5G technology in the frequency band 3.7-3.98 GHz,

- November 2020 : In France, 5G was authorized and the first base stations (BS) were activated. Considering the RTCA SC-239 report, France has taken immediate action to mitigate possible interference with radio altimeters.

Mitigation Measures in France

- What assumptions were made?

- Considering that RTCA report SC-239 only dealt with RADALT susceptibility in the 3.7-3.98GHz band, and that France intended to use the 3.4-3.8Ghz band. We considered only measurements available between 3.7-3.8Ghz, considering that the further away from the radio altimeter frequency band, the lower the susceptibility. We considered the worst case at an altitude of **200ft for an interference threshold of -19dbm in the safety zone.** And another point at **1000ft for a level of -26dbm**

Mitigation Measures in France

- What assumptions were made?

  - **Definition of the protection zones**

Two kinds of protection zones have been defined around IFR aerodromes. “

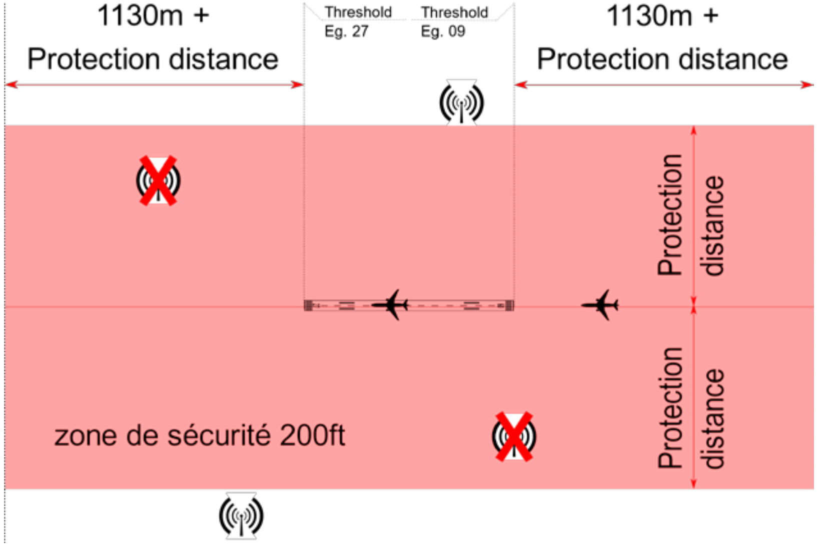
- **zone de sécurité** (safety zone) where 5G BS are not authorized to transmit. This area is defined to protect the Radio altimeters in the phase where the aircraft is at or below 200 ft (61 m)
- **zone de precaution** (precaution zone) where 5G BS implementation are coordinated. This area is defined on each side of the “zones de sécurité” to protect the landing approach below 1000 ft (305 m).

Mitigation Measures in France

- What assumptions were made?

Safety zone

- We considered a glide 3° slope with a tolerance of 0.375° (ie 2.625°). Therefore, the aircraft may be below 200 ft on a line corresponding to the runway threshold extended by 1130 m each side. **The rectangular safety zone** has a width on each side of the runway (**protection distance**) calculated with these assumptions and a length extended from each runway threshold by 1130 m + the **protection distance** (see calculation method)

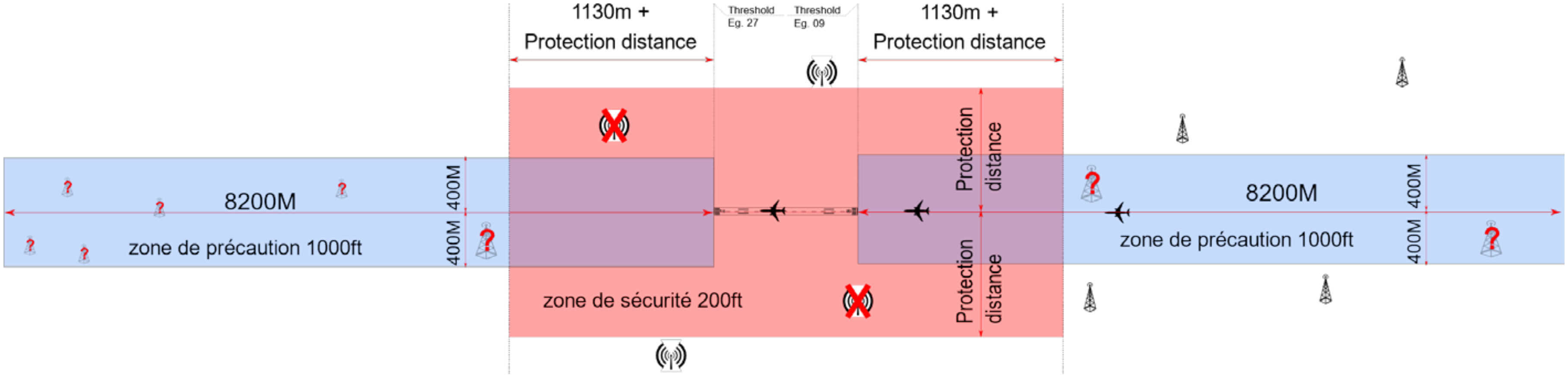


Mitigation Measures in France

• What assumptions were made?

Précaution zone

- The precaution zone does not apply in the case where calculations based on the antenna gain envelope provided by the operator and worst-case location of BS outside the safety zone show that the Radio altimeters remains protected under the assumptions.



Mitigation Measures in France

• What assumptions were made?

- BS maximum EIRP (Effective Isotropic Radiated Power).
- 6dB ICAO Safety margin for “Protection distance” calculation
- 0 dBi maximum Radio altimeters antenna gain below 3.8 GHz (RTCA Report)
- in the safety zone (aircraft flying below 200ft) : the interference threshold is -19dBm - 6dB (ICAO Safety margin)= -25dBm
- the interference threshold value between 200ft (-19dBm) and 1000ft (-26dBm) is a logarithmic evolution
  - in the precautionary zone: the interference threshold is : $-7 * \frac{Log(Alt\ ft)}{\log(5)} - 19 + 7 * \frac{2+\log(2)}{\log(5)}$

Mitigation Measures in France

- Calculation method

The protection zones dimensions are based on MCL calculations and take into account the free space model (ITU-R P.525) at the frequency of 3700 MHz.

$$\text{Free space loss: } 20 * \log\left(\frac{4 * \pi * \text{distance (m)}}{\lambda}\right) \text{ dB}$$

- **<u>protection distance</u>** is the separation distance required between a dedicated 5G BS (with a specific Maximum EIRP) and an aircraft, to achieved a sufficient free space loss in order to ensure that the 5G signal received by the radalt is below the sensitivity threshold below 200ft (-25dBm). This means that the size of the exclusion zone of a 5G BS depends on its power.

Example: Bergen (Norway) exemple,
- If the Maximum EIRP of 5G BS is 78dBm, the safety zone is the green one and the BS can't be deployed.
- If the Maximum EIRP of 5G BS is 62 dBm, the safety zone is the red one and the BS can be deployed.

Mitigation Measures in France

• Calculation method

Knowing the protection distance, we have all the elements to define the protection zone.

Example 1: What is the protection distance required for a Maximum EIRP of 78,8 dBm?

- ➢ The attenuation required is = 78,8 + 19 + 6 = 103,8 dB
- ➢ To achieve 103,8 dB free space loss at 3700 Mhz, the required/protection distance is 998,64m (~1km)

Example 2: What is the protection distance required for a Maximum EIRP of 62 dBm?

- ➢ The attenuation required is = 62 + 19 + 6 = 87 dB
- ➢ To achieve 87 dB free space loss at 3700 MHz, the required/protection distance is 144m

• Remark

5G BS could be deployed in the vicinity of an airport, if they have the adequate power.

Mitigation Measures in France

• Calculation method

The **precaution zone** is intended to protect the Radio Altimeter when the aircraft is at an altitude bellow 1000ft during final approach.

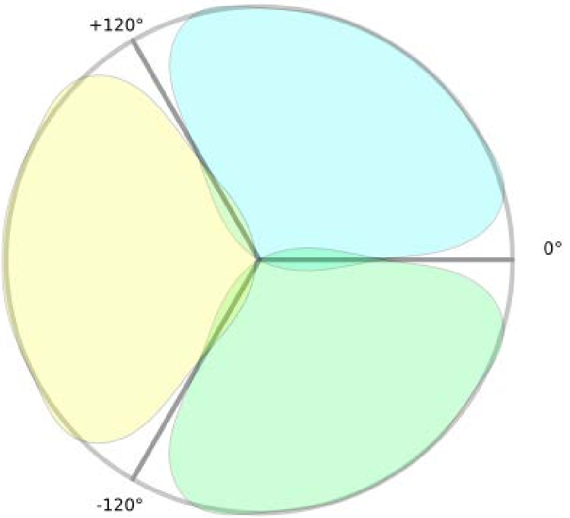
To be able to make a detailed study, you need to know

- The 5G BS Maximum EIRP
- The elevation diagram of the 5G antenna
- The terrain profile to know the relative altitude of the aircraft with respect to the ground in order to define the sensitivity threshold of the Radio altimeter

This results in relatively complex calculations, but we make these calculations on a case-by-case basis. However, it is necessary to have access to the elevation antenna pattern of the operator under study. The configuration of AAS antennas is specific to each operator, and they are generally not willing to share this information with a third party, because is considered as a trade secret.

5G antenna pattern

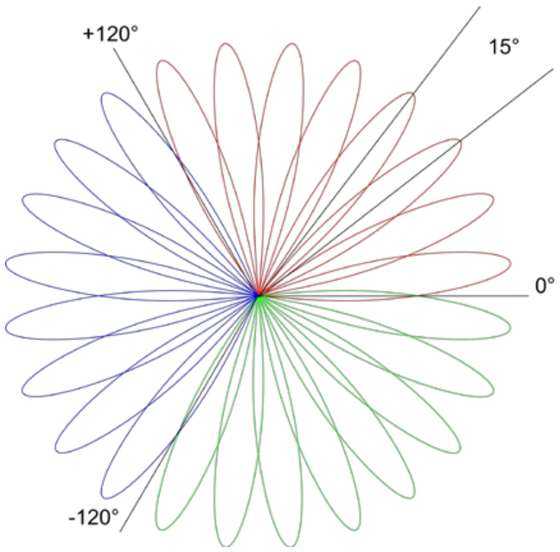
Non AAS antenna



5G antenna pattern see from above

A single IMT antenna can provide 120° coverage, therefore we see towers/base station with three antennas oriented every 120°. Antenna gain ~ dBi

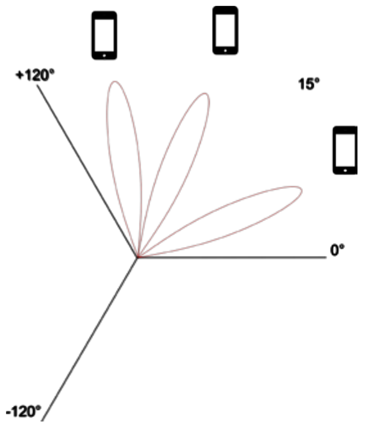
AAS antenna



5G antenna pattern see from above

As a Non-AAS, a single AAS antenna can provide 120° coverage but use beamforming technology. This means that an ASS antenna will steer a single narrower beam, at a time, within its 120° range. In France, the antennas used can create 8 separate beams, (one every 15°).
For the time being, antenna gain in one direction is up to 25 dBi but will be higher in the future (increase in the number of cells in an AAS antenna)

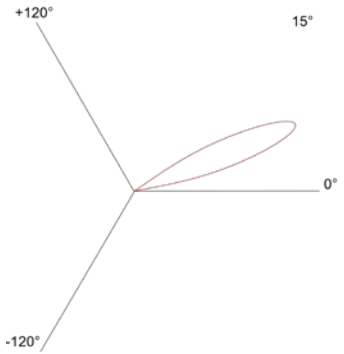
AAS antenna



5G antenna pattern see from above

AAS antennas only radiate in a single beam at a time but switch from beam to beam very quickly.
This means that the more mobiles there are in one direction, the higher power radiated in that direction!

AAS antenna



5G antenna pattern see from above

And where can you find more than 100 undisciplined people who don't put their phone in flight mode when it's been requested?
In the same direction as a radio-altimeter!

That’s why France published a **Safety info leaflet**.

Questions & Answers