
Notice of aeronautical radar coordination

Coordination procedure for air traffic control radar -
notice issued to 3.4 GHz Licensees

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1. Introduction

- 1.1 This Notice is notified to each 3.4 GHz Licensee under their respective 3.4 GHz licences. It specifies the protection thresholds and coordination procedure that Ofcom considers necessary to ensure the protection of existing radars operating in the 2.7 GHz bands from potential harmful interference from the deployment of networks in the 3.4 GHz band.
- 1.2 As part of the Award Process for licences in the 2.6 GHz spectrum band, a cross-Government radar remediation programme ensured that ATC radars in the 2.7 GHz band (2700-3100 MHz) were modified to become more resilient to interference from the 3.4 GHz Band (3410 MHz to 3600 MHz). However, the radars have retained some sensitivity to emissions from the 3.4 GHz Band.
- 1.3 In this Notice:
- “2.7 GHz band” means the following frequencies: 2700 MHz to 3100 MHz;
 - “3.4 GHz band” means the following frequencies: 3410 MHz to 3600 MHz;
 - “3.4 GHz Base Stations” means Base Stations which are licensed to transmit using frequencies in the 3.4 GHz band;
 - “3.4 GHz Deployment” means 3.4 GHz Base Stations and 3.4 GHz Fixed or Installed Terminal Stations deployed by a 3.4 GHz Licensee. For the purposes of this Notice indoor femtocells and indoor smart/intelligent repeaters, as defined in Schedule 1 of the 3.4 GHz licence, are excluded from a 3.4 GHz Deployment;
 - “3.4 GHz Fixed or Installed Terminal Stations” means fixed or installed Terminal Stations which are not exempt from licensing by the Wireless Telegraphy Act (Exemption) Regulations and which are licensed to transmit using frequencies in the 3.4 GHz band;
 - “3.4 GHz Licensee” means the licensee under a licence authorising use in the United Kingdom of frequencies in the 3.4 GHz band;
 - “Base Station” means radio equipment that transmits to Terminal Station(s);
 - “The CAA” means the Civil Aviation Authority;
 - “The in-band communications signal threshold” means the threshold that the 3.4 GHz Licensee must comply with as specified in this Notice;
 - “MOD” means the Ministry of Defence;
 - “Noise” means the non-signal component of the communications transmissions;
 - “OOB emissions” means out of communications band emissions;
 - “Protected Radar” means the list of radars set out in this Notice;
 - “Radar” means aeronautical radio-navigation radar;

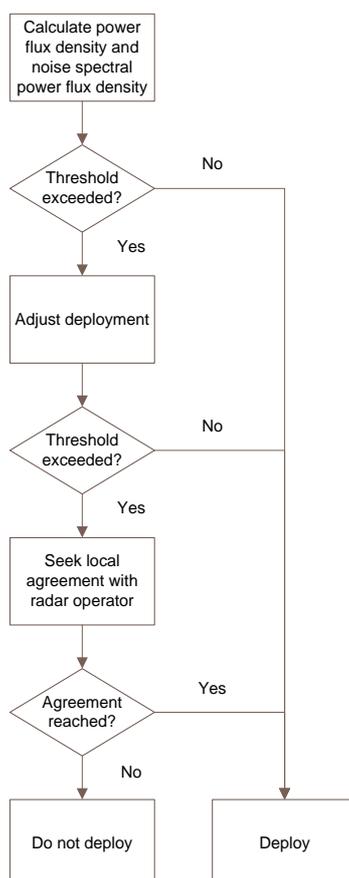
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- “Signals” means the transmission in the 3.41 to 3.6 GHz band from the 3.4 GHz communications equipment;
- “Terminal Station” means radio equipment that receives downlink transmissions from a Base Stations.

2. The procedure

- 2.1 When planning its network deployment, the 3.4 GHz Licensee must check whether the protection thresholds set out in this document would be exceeded as a result of any proposed 3.4 GHz Deployment. To do so, the 3.4 GHz Licensee will need to calculate the communications signal and the out of band noise at the relevant Protected Radar location(s) (see section below). If these calculations show that the relevant threshold(s) will not be exceeded as a result of the planned deployment, then deployment can go ahead. If the calculations show that the relevant threshold(s) would be exceeded as a result of the planned deployment, the 3.4 GHz Licensee may consider adjusting the deployment.
- 2.2 If it is not possible to adjust the deployment so that the threshold(s) are not exceeded, the 3.4 GHz Licensee may only proceed to deployment if agreement is reached with the operator(s) of the relevant radar(s).

Figure 2.1: Flowchart illustrating coordination procedures



The Protected Radar list

- 2.3 Details of the existing civil and military radars requiring protection are set out in the Protected Radar list referred to in paragraph 2.24 of this Notice. The area where the radar

is protected is limited by the current position and within the airfield boundary. The 3.4 GHz Licensee must ensure that its planned deployment is able to comply with the thresholds in relation to all of that area based on the methodology in this Notice.

- 2.4 The protection thresholds and coordination procedure apply to the protection of radars listed on the Protected Radar list at the time a new 3.4 GHz deployment is made.
- 2.5 The protection thresholds and coordination procedure do not apply to the protection of any new radar from 3.4 GHz Deployments in the 3.4 GHz band already in operation when the radar is deployed. However, where a radar operator does wish to deploy a new radar and there is a 3.4 GHz Licensee with an existing 3.4 GHz Deployment that may interfere with that new radar, it would be open to the parties to seek to resolve between themselves any coordination issues that would arise as a result of the intended radar deployment. Any such agreement must be recorded in writing in a form agreed by both the 3.4 GHz Licensee and the radar operator. The 3.4 GHz Licensee must maintain a record of all such agreements and make them available to Ofcom on request.
- 2.6 Should the parties be unable to agree a resolution to a coordination issue for a new radar at a particular airport, the parties may refer the matter to Ofcom and the CAA for assistance. Ofcom and the CAA, in consultation with the relevant parties, shall use their reasonable endeavours to agree between them and subsequently recommend a proportionate solution to the parties. Ofcom and the CAA recognise that radar operators and mobile operators are likely to have a shared interest in ensuring both aircraft safety through radar protection and availability of mobile coverage at airports. Should the parties be unwilling to accept any recommended solution Ofcom and the CAA would consider the extent to which statutory powers could be used to resolve the situation.
- 2.7 The Protected Radar list will be updated and re-issued from time to time. It is the responsibility of the 3.4 GHz Licensee to ensure that it uses the most recent version when planning its deployment.

Radar protection thresholds

- 2.8 Protected ATC Radars have been subject to remediation work to make them less susceptible to interference from signals in the 3.4 GHz Band. Figure 2.2 contains values for the in-band communications signal threshold and the threshold for communications out of band noise.
- 2.9 Subject to paragraph 2.15, in relation to each Protected Radar, the 3.4 GHz Licensee must ensure that emissions from each Base Station (based on the methodology in this annex) in the 3.4 GHz band do not exceed the threshold in Figure 2.2.

Figure 2.2: Radar protection thresholds

	In-band communication signal	Communications out of band noise
	Power flux density threshold for Signals in the 3410 to 3600 MHz band (dBm/m²) ^[1,2]	Noise spectral power flux density threshold at 2720 MHz to 3100 MHz (dBm/MHz/m²) ^[1,2]
Radar protection thresholds (per Base Station)	$5+10*\log_{10}\left(\frac{BW}{120}\right)$	$-131+10*\log_{10}\left(\frac{BW}{120}\right)$
Area where calculation is to be performed	Up to 7 km from the Protected Site location	
Where: <i>BW</i> is the total 3.4 GHz bandwidth assigned to the licensee for downlink transmissions in the band 3410 to 3600 MHz in MHz Note ^[1] : The protection thresholds are defined at the peak of the main radar beam. Note ^[2] : The protection thresholds are defined during the 'on' period of the transmit signal.		

Compliance with the thresholds

- 2.10 Prior to deployment, the 3.4 GHz Licensee must use the methodology in this Notice to assess whether the protection thresholds specified in Figure 2.2 will be exceeded as a result of its planned deployment in the 3.4 GHz band for any Protected Radar.
- 2.11 In carrying out this assessment the 3.4 GHz Licensee must use the appropriate propagation model as follows:
- For 3.4 GHz Deployments further than 1.5km from the Protected Radar, ITU-R P.452-16 with the parameters given in Figure 2.3.
 - For 3.4 GHz Deployments at or within 1.5km from the Protected Radar, ITU-R P.525-2 (Free Space Path Loss) + 6 dB additional margin¹.
- 2.12 The 3.4 GHz Licensee must ensure that the protection thresholds are not exceeded in any pointing direction of the Protected Radar antenna. The radar antenna peak gain (which is 34 dBi in the main beam direction) is accounted for in the protection thresholds .
- 2.13 The field strength is the value that must not exceed threshold limits. The 3.4 GHz Licensee must take into account in its analysis the OOB emissions that would be generated in the presence of closely spaced 3.4 GHz Deployments.
- 2.14 The 3.4 GHz Licensee must maintain records of its calculations and assessments and make these available to Ofcom if required.

¹ This margin accounts for multipath. It represents a single multipath Base Station signal reflection received coherently at the radar via a reflecting structure or surface (i.e. buildings, vehicles, pylons, reflective ground structures, etc.). This is assumed when a Base Station is located within 1.5km range of the radar.

Exceeding the threshold

2.15 The thresholds may only be exceeded in relation to a specific Protected Radar if the 3.4 GHz Licensee has reached an agreement with the operator of that Protected Radar. However, any such agreement would be limited to that specific Protected Radar, and would not remove the obligation of the 3.4 GHz Licensee to comply with the relevant thresholds in relation to other Protected Radars. Any such agreement must be recorded in writing in a form agreed by both the 3.4 GHz Licensee and the radar operator. The 3.4 GHz Licensee must maintain a record of all such agreements, and make them available to Ofcom on request.

Propagation Model

- 2.16 The path loss will be calculated using Recommendation ITU-R P.452-16 “Prediction procedure for the evaluation of microwave interference between stations on the surface of the Earth at frequencies above 0.7 GHz”².
- 2.17 It predicts signal levels exceeded for a given percentage of time, the assessment will use a time percentage of 0.1% as included in the table below.
- 2.18 Predictions are based on the terrain profile and clutter along the path.
- 2.19 A propagation correction due to clutter shall be applied. This is based on a representative clutter height assigned to each clutter category.

Figure 2.3: ITU-R P.452 parameters

Time percentage	0.1%
Sea level surface refractivity, N_0 (N-units)	325
The average radio-refractive index lapse-rate through the lowest 1km of the atmosphere, ΔN (N-units/km)	45
Dry air pressure (hPa)	1013
Temperature (°C)	15.0
Nominal path centre latitude φ (°)	51.0
Clear-air propagation attenuation components included:	Line of sight/Diffraction - Diffraction - Multipath and focusing effects - Gaseous absorption Tropospheric scatter - Gaseous absorption Ducting/Layer reflection - Gaseous absorption

² www.itu.int/rec/R-REC-P.452/en

The path centre latitude φ may be selected on a case by case basis, in this case N_0 and ΔN should be calculated using the following equations:

$$N_0 = 328 - (\varphi - 50); \quad \Delta N = 42.5 - 0.25(\varphi - 50)$$

Terrain database

- 2.20 Digital terrain map data with 50m resolution shall be used. Examples include Ordnance Survey “Landform Panorama®” or “OS Terrain® 50” datasets³.

Clutter database

- 2.21 A digital land classification (“clutter”) dataset with 50m resolution such as “Infoterra 50m clutter”⁴ or other equivalent shall be used.
- 2.22 The Infoterra dataset identifies 10 different clutter categories. For location variation these are mapped to the required clutter designations with nominal clutter heights and nominal obstacle distances.
- 2.23 The default parameters, given in Figure 2.4 for nominal clutter heights and nominal obstacle distances are as defined in ITU-R P.452-16.

Figure 2.4: Infoterra clutter code mapping

Infoterra Clutter Code	Description	Nominal height (m)	Nominal distance (km)
0	Open	4	0.1
1	Suburban	9	0.025
2	Urban	20	0.02
3	Villages	5	0.07
4	Open in Urban	4	0.1
5	Forest	15	0.05
6	Water	0	Not applicable
7	Dense Urban	25	0.02
8	Park recreation	4	0.1
10	Industry	20	0.05

³ <http://www.ordnancesurvey.co.uk/business-and-government/products/opendata-products-grid.html>

⁴ <http://www.space-airbusds.com>

List of military and civil radars to be protected

- 2.24 The radars to which these coordination procedures apply can be found at: http://stakeholders.ofcom.org.uk/binaries/spectrum/clearance-coexistence/Protected_radar.pdf. The list was updated on 2 October 2017.
- 2.25 The area where a radar is protected is limited by the current position and within the airfield boundary⁵. This list will be periodically updated.

⁵ The CAA has records of airfield boundaries as part of its aerodrome licensing, available at <http://www.caa.co.uk/default.aspx?catid=375&pagetype=90&pageid=5373>.