



Notice of coordination procedure required under spectrum access licences for the 2.6 GHz band

Coordination with aeronautical
radionavigation radar in the 2.7
GHz band

Notice

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Section 1

Introduction

- 1.1 This Notice is notified to each 2.6 GHz licensee under their respective 2.6 GHz licences.
- 1.2 There is a cross-Government radar remediation programme in place to ensure that radars in the 2.7 GHz band (2700-3100 MHz) are modified to become more resilient to interference from the 2.6 GHz band (2500 MHz to 2690 MHz). However, even after this programme is completed the radars will have some sensitivity to emissions from the 2.6 GHz band.
- 1.3 This Notice specifies the protection thresholds and coordination procedure that Ofcom considers are 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 2.6 GHz band.
- 1.4 There are different protection thresholds before and after radars are modified. The protection thresholds will be less restrictive once the modification has been completed at each radar site.

- 1.5 In this Notice:

“2.6 GHz band” means the following frequencies: 2500 MHz – 2690 MHz;

“2.6 GHz base stations” means base stations which are licensed to transmit using frequencies in the 2.6 GHz band;

“2.6 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 2.6 GHz band;

“2.6 GHz licensee” means the licensee under a licence authorising use in the United Kingdom of frequencies in the 2.6 GHz band;

“2.7 GHz band” means the following frequencies: 2700 MHz – 3100 MHz;

“base station” means radio equipment that transmits to terminal stations;

“2.6 GHz deployments” means 2.6 GHz bases stations and 2.6 GHz fixed or installed terminal stations deployed by a 2.6 GHz licensee;

“the CAA” means the Civil Aviation Authority;

“the in-band communications signal threshold” means the threshold that the 2.6 GHz licensee must comply with as specified in this Notice;

“MOD” means the Ministry of Defence;

“OOB emissions” means out of band emissions;

“Protected Radar” means the list of radars set out at Annex 3 to this Notice;

“radar” means aeronautical radionavigation radar; and

“terminal station” means Radio Equipment that receives downlink transmissions from base stations.

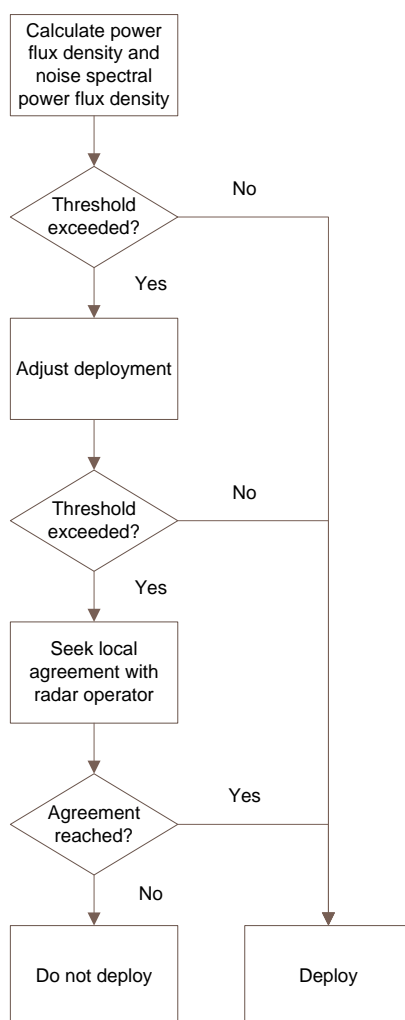
Section 2

The coordination procedure

Overview of procedure

- 2.1 When planning its network deployment, the 2.6 GHz licensee must check whether the protection thresholds set out in this document would be exceeded as a result of any proposed 2.6 GHz deployment. To do so, the 2.6 GHz licensee will need to calculate the communications signal and the out of band noise at the relevant Protected Radar location(s) (see section 4). 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 2.6 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 2.6 GHz licensee may only proceed to deployment if agreement is reached with the operator(s) of the relevant radar(s).

Flowchart illustrating coordination procedures



Section 3

Radars to be protected

The Protected Radar list

- 3.1 Details of the existing civil and military radars requiring protection are set out in the Protected Radar list at Annex 3 to this Notice. The area where the radar is protected is limited by the current position and within the airfield boundary. The 2.6 GHz licensee must ensure that its planned deployment is able to comply with the thresholds in relation to all of that area.
- 3.2 The protection thresholds and coordination procedure apply to the protection of radars listed on the Protected Radar list at the time a new 2.6 GHz deployment is made.
- 3.3 The protection thresholds and coordination procedure do not apply to the protection of any new radar from 2.6 GHz deployments in the 2.6 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 2.6 GHz licensee with an existing 2.6 GHz deployments 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 2.6 GHz licensee and the radar operator. The 2.6 GHz licensee must maintain a record of all such agreements, and make them available to Ofcom on request.
- 3.4 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.
- 3.5 The Protected Radar list will be updated and re-issued from time to time. It is the responsibility of the 2.6 GHz licensee to ensure that it uses the most recent version when planning its deployment.

Section 4

Radar protection thresholds

Protection thresholds

- 4.1 Protected Radars are subject to remediation work to make them less susceptible to interference from signals in the 2.6 GHz band. Table 1 contains two values for the in-band communications signal threshold, one value for pre-remediation and one value for post-remediation. The threshold for communications out of band noise remains the same before and after radars have been modified.
- 4.2 Subject to paragraph 4.9, in relation to each Protected Radar:
- 4.2.1 Before that Protected Radar has been remediated, the 2.6 GHz licensee must ensure that cumulative emissions from all deployment in the 2.6 GHz band do not exceed the pre-remediation threshold in Table 1.
- 4.2.2 After that Protected Radar has been remediated, the 2.6 GHz licensee must ensure that cumulative emissions from all deployment in the 2.6 GHz band do not exceed the post-remediation threshold in Table 1.
- 4.3 The Protected Radar list at Annex 3 (as updated and re-issued from time to time) specifies which Protected Radars have been remediated.

Table 1: Radar protection thresholds

	In-band communication signal		Communications out of band noise
	Pre-remediation	Post-remediation	Pre- and post-remediation
	Power flux density threshold for signals in the 2570-2690 MHz band (dBm/m ²) ^[1,2]	Power flux density threshold for signals in the 2570-2690 MHz band (dBm/m ²) ^[1,2]	Noise spectral power flux density threshold at 2720 MHz to 3100 MHz (dBm/MHz/m ²) ^[1,2]
Radar protection thresholds	$-74 + 10 \cdot \log_{10} \left(\frac{BW}{120} \right)$	$5 + 10 \cdot \log_{10} \left(\frac{BW}{120} \right)$	$-131 + 10 \cdot \log_{10} \left(\frac{BW}{120} \right)$
Where: <i>BW</i> is the total 2.6 GHz bandwidth assigned to the licensee for downlink transmissions (combining both paired and unpaired spectrum) in the band 2570 – 2690 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

- 4.4 Prior to deployment, the 2.6 GHz licensee must assess whether the protection thresholds specified in Table 1 will be exceeded as a result of its planned deployment in the 2.6 GHz band for any Protected Radar.
- 4.5 In carrying out this assessment the 2.6 GHz licensee must use the appropriate propagation model as follows:
 - 4.5.1 For 2.6 GHz deployments further than 1.5 km from the Protected Radar, ITU-R P.452-14 with the parameters given in Annex 1.
 - 4.5.2 For 2.6 GHz deployments at or within 1.5 km from the Protected Radar, ITU-R P.525-2 (Free Space Path Loss) + 6 dB additional margin¹.
- 4.6 The 2.6 GHz licensee must ensure that the protection thresholds are not exceeded in any pointing direction of the Protected Radar antenna using the relative horizontal antenna gain pattern described in Annex 2. The horizontal radar polar diagram will be used to sum all the communications signals according to the radar antenna sensitivity in different horizontal directions. The radar antenna peak gain is accounted for in the protection thresholds and radar antenna polar diagrams provided are referenced to the maximum radar antenna gain.
- 4.7 The summed field strength is the value that must not exceed threshold limits. The 2.6 GHz licensee must take into account in its analysis the OOB emissions that would be generated in the presence of closely spaced 2.6 GHz deployments.
- 4.8 The 2.6 GHz licensee must maintain records of its calculations and assessments and make these available to Ofcom if required.

Exceeding the threshold

- 4.9 The thresholds may only be exceeded in relation to a specific Protected Radar if the 2.6 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 2.6 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 2.6 GHz licensee and the radar operator. The 2.6 GHz licensee must maintain a record of all such agreements, and make them available to Ofcom on request.

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 1.5 km range of the radar.

Annex 1

Modelling parameters

Propagation model

- A1.1 The path loss will be calculated using Recommendation ITU-R P.452 “Prediction procedure for the evaluation of microwave interference between stations on the surface of the Earth at frequencies above 0.7 GHz”².
- A1.2 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.
- A1.3 Predictions are based on the terrain profile and clutter along the path.
- A1.4 A propagation correction due to clutter shall be applied. This is based on a representative clutter height assigned to each clutter category.

Table A1.1: ITU-R P.452

Time percentage	0.100%
Sea level surface refractivity N0	325
deltaN = [N(0m) - N(1000m)]	45
Dry air pressure (hPa)	1013
Temperature (°C)	15.0
Nominal path center latitude (°)	51.0
Clear-air propagation attenuation components included:	Line of sight/Diffraction - Diffraction - Multipath and focussing effects - Gaseous absorption Tropospheric scatter - Gaseous absorption Ducting/Layer reflection - Gaseous absorption
The path centre latitude may be selected on a case by case basis.	

Terrain database

- A1.5 Ordnance Survey “Land-form Panorama[®]” 50 m resolution digital terrain map data shall be used.

Clutter database

- A1.6 The 50 metre resolution clutter dataset produced by Infoterra shall be used.

² www.itu.int/rec/R-REC-P.452/en

- A1.7 This dataset identifies 10 different clutter categories. For location variation these are mapped to the required clutter designations with heights.
- A1.8 The default parameters for representative clutter heights are as defined in ITU-R P.452.

Table A1.2: Infoterra clutter code mapping

Infoterra Clutter Code	Description	Nominal height (m)
0	Open	4
1	Suburban	9
2	Urban	20
3	Villages	5
4	Open in Urban	4
5	Forest	15
6	Water	0
7	Dense Urban	25
8	Park recreation	4
10	Industry	20

Annex 2

Antenna pattern

Radar horizontal antenna pattern

A2.1 The table below shows the radar horizontal antenna pattern (symmetrical about 180 degrees) that must be used for power density calculations.

Table A2.1: Antenna pattern

Angle from boresight (degrees)		Gain wrt to peak (dB)
At or above angle:	Below angle:	
0	0.5	0
0.5	0.6	-1
0.6	0.7	-2
0.7	0.8	-3
0.8	0.9	-5
0.9	1	-7
1	2	-10
2	3	-15
3	4	-30
4	15	-20
15	16	-25
16	30	-30
30	31	-35
31	60	-40
60	61	-35
61	120	-30
120	121	-35
121	180	-40

Annex 3

Protected Radar list

List of military and civil radars to be protected

A3.1 The radars to which these coordination procedures apply are listed in the table below. The area where the radar is protected is limited by the current position and within the airfield boundary³.

A3.2 This list was issued on 1 March 2013

Table A3.1: Protected radar list

Name	Location	Post Code	Remediated
Allanshill radar station	Postcode nearest to the site	AB43 7LS	No
Belfast City Airport	Sydenham by-Pass Belfast	BT3 9JH	No
Belfast International	Belfast	BT29 4AB	No
Birmingham International Airport	Diamond House Birmingham	B26 3QJ	No
Blackpool Airport	Squires Gate Lane Blackpool	FY4 2QS	No
Bournemouth International Airport	Hurn, Christchurch Dorset	BH23 6SE	No
Bristol Airport	Control Tower Building Bristol	BS48 3DY	No
Cambridge Airport	Newmarket Road Cambridge	CB5 8RX	No
Cardiff International Airport	Rhoose, Barry South Glamorgan	CF62 3BD	No
Coventry Airport	Siskin Parkway West Middlemarch Business Park Coventry	CV3 4PB	No
Cromer radar station	Postcode nearest to the site	NR27 0NQ	No
Cumbernauld wind farm	1 Waterloo Street Glasgow	G2 6AY	No
Durham Tees Valley Airport	Darlington County Durham	DL2 1LU	No
East Midlands International Airport	Castle Donington Derby	DE74 2SA	No

³ 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>.

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Edinburgh Airport	Edinburgh Lothian	EH12 9DN	Yes
Exeter & Devon Airport	Clyst Honiton Exeter	EX5 2BD	No
Farnborough Aerodrome	Farnborough Hampshire	GU14 6XA	No
Glasgow Airport	Paisley Strathclyde	PA3 2ST	Yes
Glasgow Prestwick Inter Airport	Prestwick Ayrshire	KA9 2PL	No
Hawarden Airport	Broughton Chester North Wales	CH4 0DR	Yes
Hibaldstow radar station	New Control Tower Oglet Lane Hale Village Liverpool	L24 5RJ	No
Humberside Airport	Kirmington Ulceby South Humberside	DN39 6YH	No
Inverness Airport	Inverness	IV2 7JB	No
Kincardine radar station	Postcode nearest to the site	FK10 4BJ	Yes
Leeds Bradford International Airport	Yeadon Leeds	LS19 7TU	No
Liverpool Airport	Liverpool	L24 1YD	No
London Gatwick Airport	West Sussex	RH6 0NP	No
London Heathrow Airport	Hounslow Middlesex	TW6 2QW	No
Stansted Airport	Stansted Essex	CM24 1QW	No
Manchester Airport	Manchester	M90 1QX	No
Manchester Airport (future system)	Manchester	M90 1QX	No
Manston Airport	Manston Ramsgate Kent	CT12 5BP	No
Newcastle International Airport	Woolsington Newcastle upon Tyne	NE13 8BZ	No
Newquay Cornwall Airport	Carloggas St. Mawgan Newquay Cornwall	TR8 4RQ	No
Norwich Airport	Amsterdam Way Norwich	NR6 6JA	Yes
Oxford Airport	Langford Lane Kidlington Oxfordshire	OX5 1RA	No
Robin Hood Airport	Hayfield Lane Doncaster South Yorkshire	DN9 3XA	No

Southampton International Airport	Southampton Hampshire	SO18 2NL	No
London Southend Airport	Southend-on-Sea Essex	SS2 6YF	No
St Annes radar station	North Houses Lane Lytham St Annes	FY8 4NU	No
Sumburgh Airport	Virkie Shetland	ZE3 9JP	No
Aberporth	Parcllyn Cardigan Ceredigion	SA43 2BU	No
Albermarle Barracks	Ouston, Newcastle Upon Tyne	NE15 0RF	No
Benbecula Airfield	Benbecula, Outer Hebrides	HS7 5LW	No
Benson	Wallingford Oxon	OX10 6AA	No
Boscombe Down	Salisbury Wiltshire	SP4 OJF	No
Brize Norton	Oxford	OX18 3LX	No
Brizlee Wood	Alnwick Northumberland	NE66 3HX	No
Cawdor Barracks (RAF Brawdy)	Postcode nearest to the site.	SA62 6NN	No
Coningsby	Lincoln	LN4 4SY	No
Cosford	Wolverhampton	WV7 3EX	No
Cosford T101	Wolverhampton	WV7 3EX	No
Cosford Tac	Wolverhampton	WV7 3EX	No
Cranwell	Sleaford Lincs	NG34 8HB	No
Culdrose	Helston Cornwall	TR12 7RH	No
Hartland Point	Postcode nearest to the site.	EX39 6AU	No
Honington	Bury St Edmunds Suffolk	IP31 1EE	No
Lakenheath	Brandon Suffolk	IP27 9PN	No
Leeming	Northallerton North Yorkshire	DL7 9NJ	No
Leuchars	Leuchars Fife	KY16 0JX	No
Linton-on-Ouse	York North Yorkshire	YO30 2AJ	No
Lossiemouth	Lossiemouth Moray	IV31 6SD	No
Manorbier	Tenby Dyfed	SA70 7SH	No
Marham	King's Lynn Norfolk	PE33 9NP	No
Middle Wallop	Stockbridge Hampshire	SO20 8DY	No
Odiham	Hook Hampshire	RG29 1QT	No
Otterburn Barracks	Northumberland Postcode nearest to the site.	NE19 1NX	No

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Portland	Portland Dorset	DT5 1EQ	No
Portreath	Redruth Cornwall	TR16 4RA	No
RAF Boulmer	Alnwick Northumberland	NE66 3JF	No
RAF Kirton-in-Lindsay	Gainsborough, Lincolnshire	DN21 4HY	No
Robertson Barracks	Swanton Morley, Norfolk	NR20 4TX	No
Saxa Vord	Haroldswick, Unst Shetland Islands, Outer Hebrides	ZE2 9TJ	No
Scampton	Lincoln	LN1 2ST	No
Shawbury	Shrewsbury Shropshire	SY4 4DZ	No
Spadeadam BH	Gilsland , Brampton, Cumbria	CA8 7AT	No
Spadeadam DWF	Postcode nearest to the site.	NE48 1ER	No
St Kilda Airwatch	There is no postcode available		No
St Kilda Seawatch	There is no postcode available		No
Staxton Wold	Scarborough North Yorkshire	YO12 4TJ	No
Thorny Island	Emsworth, Hampshire	PO10 8DH	No
RRH Trimmingham	Trimingham, Norfolk	NR11 8HY	No
Topcliffe	Thirsk North Yorkshire	YO7 3QE	No
Valley	Holyhead Isle of Anglesey	LL65 3NY	No
Waddington	Lincoln Lincolnshire	LN5 9NB	No
Wembury Point	Postcode nearest to the site.	PL9 0BG	No
West Freugh	Stranraer Wigtownshire	DG9 9DN	No
Wittering	Peterborough	PE8 6HB	No
Yeovilton	Ilchester Somerset	BA22 8HT	No