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Protecting passive services at 23.6-24 GHz from future 26 GHz uses

Additional measures to protect radio astronomy service and earth exploration satellite service (passive) use at 23.6-24 GHz from out-of-band emissions from deployments at 24.25-27.5 GHz (26 GHz)

CONSULTATION:

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Section

Annex

1. Overview

We are currently preparing to authorise access to the 26 GHz (24.25-27.5 GHz) band for future outdoor wireless broadband services. The 26 GHz band was globally identified for mobile services in 2019 and is a pioneer 5G band in Europe. Access to this spectrum will enable consumers to benefit from a range of connectivity needs such as mobile services, including 5G and wireless broadband. In addition, part of this band has already been made available in the UK for indoor-only deployment.

Whilst enabling the benefits to consumers of future 26 GHz uses, it is important that passive services uses in the nearby 24 GHz band (23.6-24 GHz) that also benefit consumers and society are protected from out-of-band emissions from future wireless broadband services operating in the 26 GHz band.

The services that operate in the 24 GHz band are important for taking scientific measurements. These are taken from the Earth from radio astronomy sites located in the UK to enable new scientific discoveries. They are also taken from space using satellites which measure naturally occurring radiofrequency emissions from the Earth's surface and atmosphere to help predict our weather and contribute to understanding climate change. These 24 GHz uses receive radio frequency emissions at very low power requiring sensitive receivers which makes them susceptible to out-of-band emissions received from services in nearby bands such as the 26 GHz.

Studies have been conducted internationally to set harmonised limits on the out-of-band emissions from 26 GHz uses that are received in the 24 GHz band to protect the Earth exploration satellite services. We are planning to implement these limits, as required by UK law. Specifically, these limits are applicable in two stages: (i) the initial limits are applicable until 1 January 2024 and (ii) the final limits, which are more stringent, are applicable after that date.

The purpose of this consultation is to consider whether, in addition to these harmonised limits, further measures should apply in the UK to ensure the appropriate protection of the radio astronomy service and the Earth exploration satellite service operating in the 24 GHz band. We are proposing to impose the additional measures set out below, which would be included in future authorisations for 26 GHz deployments.

We are also proposing two changes to the current 26 GHz indoor shared access licence product: (a) removing the existing 1 km exclusion zones around two radio astronomy sites (Jodrell Bank and Cambridge) and (b) revising the current limits on out-of-band emissions so that they would be in line with the harmonised limits.

Our proposals

We are making proposals to protect the Radio Astronomy and passive Earth Exploration Satellite Services that operate in the 24 GHz band from out-of-band emissions from terrestrial systems capable of providing wireless broadband electronic communications operating in the 26 GHz band. Our proposals would apply to the following authorisations:

a) New uses (5G and other wireless broadband technologies) that we are preparing to authorise as part of our work to enable access to the 26 GHz band and

b) Indoor-only authorisations that we have already enabled in part of the 26 GHz band.

The measures which we are proposing would be additional to the harmonised limits on out-of-band emissions, which we are planning to implement as required by UK law. Specifically, these limits are applicable in two stages: (i) the initial limits are applicable until 1 January 2024 and (ii) the final limits, which are more stringent, are applicable after that date.

We are proposing the following additional measures:

To protect the Earth Exploration Satellite Service (passive) at 24 GHz

We are proposing to limit the number (within any 300 km^2 area) of outdoor 26 GHz base stations deployed in the lowest 800 MHz of the 26 GHz band (i.e. 24.25-25.05 GHz).

To protect the Radio Astronomy Service in the 24 GHz band

i. For **outdoor 26 GHz use**, we are proposing to apply exclusion zones around the 6 radio astronomy sites that comprise the e-MERLIN array in which the deployment of 26 GHz base stations would not be permitted. These exclusion zones would be as follows:

- *In the lowest 800 MHz of the band (24.25-25.05 GHz)* - the deployment of any base station operating at these frequencies which is brought into use before 1 January 2024 would not be permitted within a distance of 4.5 km from the radio astronomy sites; for any base station which is brought into use after 1 January 2024, the relevant distance would be 2.5 km;
- *Between 25.05 and 27.5 GHz* - the deployment of any base station operating at these frequencies which is brought into use before 1 January 2024 would not be permitted within a distance of 1.5 km from the radio astronomy sites; for any base station which is brought into use after 1 January 2024, the relevant distance would be 1 km.

ii. For **indoor 26 GHz use**, our provisional view is that additional measures are not required to protect the e-MERLIN array. We therefore propose to remove the existing 1 km exclusion zones around Jodrell Bank and Cambridge radio astronomy sites from the current 26 GHz indoor shared access licence product.

The overview section in this document is a simplified high-level summary. The proposals we are consulting on and our reasoning are set out in the full document.

We invite any comments on the proposals in this document by 5pm on 24 February 2022 and we expect to publish our conclusions in the second half of 2022.

2. Introduction

2.1 The radio spectrum is a valuable and limited natural resource and demand is ever-increasing as new wireless technologies and systems are developed. It is therefore more important than ever before that the spectrum available is used efficiently and that we continue to explore opportunities, enabled by technology, to open up spectrum at higher frequencies. As demand for spectrum access increases, the need for spectrum users to coexist is also rising.

2.2 We are currently preparing to authorise access to the 26 GHz (24.25-27.5 GHz) band for future wireless broadband services. The 26 GHz band was identified on a global basis for International Mobile Telecommunications (IMT) at the 2019 World Radiocommunication Conference (WRC-19) by amendments to the Radio Regulations of the International Telecommunications Union[1]. The 26 GHz band was also adopted as a pioneer band for 5G, in Europe with harmonised technical conditions[2], which are now part of UK law.[3]

2.3 Access to the 26 GHz band will enable consumers to benefit from a range of connectivity needs such as mobile services, including 5G and other wireless broadband services. It should be noted that part of this band has already been made available in the UK for indoor-only wireless broadband.[4]

2.4 Whilst enabling the benefits of 26 GHz uses for consumers, it is important that uses in the nearby 24 GHz band (23.6-24 GHz) are protected from out-of-band emissions from use of the 26 GHz band.

2.5 The 24 GHz uses that we are considering in this consultation have primary allocations in the Radio Regulations and are listed below and shown in Figure 1. The existing uses at 24 GHz are:

a) The Radio Astronomy Service (RAS) and,

b) The Earth Exploration Satellite Service (passive) (EESS (passive))

2.6 The harmonised conditions include limits on out-of-band emissions from future terrestrial systems capable of providing wireless broadband electronic communications in the 26 GHz

[1] The ITU Radio Regulations footnote **5.532AB** states that the frequency band 24.25-27.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. Resolution **242** (WRC-19) applies. (WRC-19)

[2] Commission Implementing Decision (EU) 2019/784 of 14 May 2019 on harmonisation of the 24,25-27,5 GHz frequency band for terrestrial systems capable of providing wireless broadband electronic communications services in the Union. A consolidated text is available here. This decision has been developed on the basis of studies conducted by CEPT in ECC Decision (18)06 on the harmonised technical conditions for Mobile/Fixed Communications Networks (MFCN) in the band 24.25-27.5 GHz, as amended on 20 November 2020 - https://docdb.cept.org/document/3361

[3] Decision 2019/784 and Decision 2020/590 continue to be part of UK law, following Brexit, by virtue of section 3 of the EU Withdrawal Act 2018. See: https://www.legislation.gov.uk/eudn/2019/784/contents, and https://www.legislation.gov.uk/eudn/2020/590/contents.

[4] https://www.ofcom.org.uk/__data/assets/pdf_file/0033/157884/enabling-wireless-innovation-through-local-licensing.pdf

band to ensure the protection of RAS and EESS (passive) in the 24 GHz band. For ease of reference, we refer to these limits as the "**harmonised limits on out-of-band emissions**".

2.7 The harmonised limits on out-of-band emissions are shown in Table 1 below.

Table 1: Harmonised limits on out-of-band emissions

	Base stations			Terminal stations		
	Frequency range	**Maximum Total Radiated Power[5]**	**Measurement bandwidth**	**Frequency range**	**Maximum Total Radiated Power**	**Measurement bandwidth**
Initial limit applies to stations deployed before 1 January 2024	23.6-24 GHz	-33 dBW	200 MHz	23.6-24 GHz	-29 dBW	200 MHz
Final limit applies to stations deployed from 1 January 2024	23.6-24 GHz	-39 dBW	200 MHz	23.6-24 GHz	-35 dBW	200 MHz

2.8 We are required by UK law[6] to implement these harmonised limits on out-of-band emissions in (i) any new spectrum access licences authorising use of 26 GHz spectrum, and (ii) the existing indoor-only shared access licence product for 26 GHz spectrum[7].

2.9 This consultation considers whether we should impose additional measures on the use of 26 GHz to ensure appropriate protection of existing uses of spectrum in the 24 GHz band from out-of-band emissions, while not restricting 26 GHz uses any more than necessary.

2.10 In the technical analysis that we have carried out to inform our view on the need for additional measures, we have considered the following new 26 GHz uses:

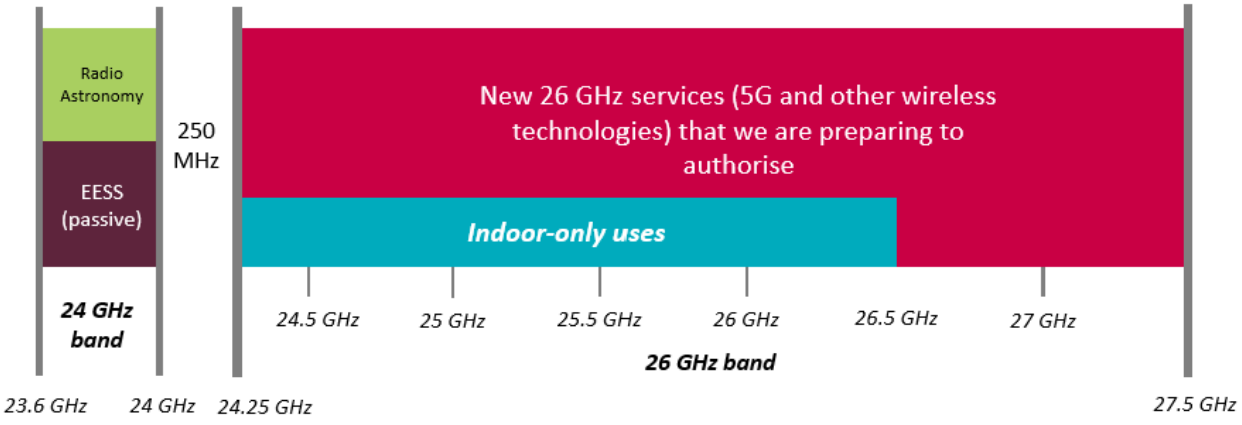
a) New[8] wireless broadband services, including 5G mobile and other technologies that we are preparing to authorise as part of our work to enable access to the 26 GHz band and,

[5] Total radiated power (TRP) is a measure of how much power a composite antenna radiates. It equals the total conducted power input into the antenna array system less any losses in the antenna array system. TRP means the integral of the power transmitted in different directions over the entire radiation sphere as shown in the formula:
where P(θ,ϕ) is the power radiated by an antenna array system in direction (θ,ϕ) given by the formula:
$P(\vartheta,\varphi) = P_{Tx}g(\vartheta,\varphi)$
where P_{Tx} denotes the conducted power (measured in Watts), which is input into the array system, and g(θ,ϕ) denotes the array systems directional gain along the (θ, ϕ) direction.
[6] Articles 2 and 3 of Decision 2019/784, as amended by Decision 2020/590.
[7] Shared access licensing: https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/shared-access
[8] We will continue to work with MOD to understand their current and future uses at 26 GHz and any measures needed to ensure the appropriate protection of the Radio Astronomy Service and Earth Exploration Satellite Service (passive)

b) Indoor-only uses that we have enabled in part of the 26 GHz band.

2.11 As mentioned above, these specific uses are covered by the harmonised limits on out-of-band emissions. It should be noted that there are other uses[9] which currently have allocations in the 26 GHz band in the UK, however they are outside the scope of this consultation.

Figure 1: Uses of 24 GHz and 26 GHz considered in this consultation



How the Radio Astronomy Service and Earth Exploration Satellite Service (passive) use the 24 GHz frequency band

2.12 The RAS and EESS in 24 GHz are passive (receive-only) services that perform important scientific measurements. The sensors on the EESS (passive) satellites and RAS sites need to collect natural radiation at very low power levels and they are likely to find it difficult to distinguish the wanted naturally occurring signals they are intended to measure from any out-of-band emissions from the 26 GHz band.

The Radio Astronomy Service

2.13 Radio astronomy is used to study the naturally occurring radio emissions from stars, galaxies and other objects in the universe. RAS observations help improve our understanding of the universe and help investigation of cosmic phenomena. Radio astronomy frequencies are largely governed by the physical characteristics of the extraterrestrial radiations and fundamental physical constants, which means that radio astronomers, unlike some other radio users, have little choice about the frequencies they use.

2.14 In the 24 GHz band, measurements taken by the radio astronomy receivers are important for a range of scientific questions such as Ammonia (NH3) line studies, whose distribution

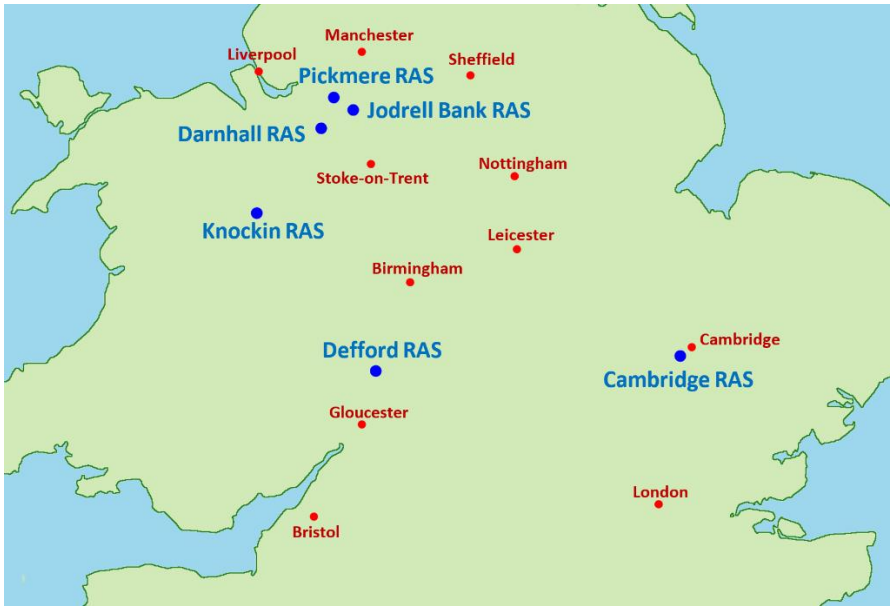
[9] Existing allocations between 24-26.5 GHz which would not be affected by the proposals in this consultation are: short range devices (21.6-27 GHz); Programme Making and Special Events (24.25-25 GHz); Fixed Links (24.5-26.5 GHz); Earth Stations of the Earth Exploration Satellite Service and Space Research Service (25.5-26.5 GHz).

in the galaxy is used in studies on interstellar chemistry. The measurements made at 24 GHz cover 6 RAS sites (see Figure 2) that operate as a radio telescope array called the e-MERLIN[10] network.

2.15 Radio astronomy research using e-MERLIN makes observations across a wide range of frequencies helping to answer many important scientific questions regarding the universe, including how galaxies and planets evolve.

2.16 e-MERLIN is a key component of the global network of radio astronomy facilities (VLBI[11]) and complementary to the capability of the Square Kilometre Array (SKA[12]) in which the UK is investing around £300M over the next 10 years. The operation of e-MERLIN will contribute towards how the SKA works and delivers science. Radio astronomy research in the UK is funded by the Science and Technology Facilities Council (STFC)[13].

Figure 2: Map showing location of e-MERLIN sites



The Earth Exploration Satellite Service (passive)

2.17 One of the main activities of the EESS (passive) is to provide information for studies of climate change and weather forecasting/warnings for national and global applications.

2.18 EESS (passive) frequency bands are determined by physics which means that, unlike some other radio uses, there is little choice about the frequencies used. Measurements in numerous different frequency bands are needed collectively to inform climate studies and weather forecasting; and continuity of observations is essential over a long timescale.

[10] e-MERLIN is the UK's national interferometer radio telescope array operated by Jodrell Bank for the Science and Technology Council (STFC).
[11] Very-long-baseline interferometry (VLBI)
[12] The Square Kilometre Array (SKA) jointly funded intergovernmental project to build world's most powerful radio astronomy facilities in Australia and South Africa with headquarters in the UK.
[13] STFC is part of UKRI (UK Research and Innovation) a non-departmental public body sponsored by the Department for Business, Energy and Industrial Strategy (BEIS)

2.19 The EESS (passive) operating at 24 GHz is used to measure sea and land surface temperature and the water vapour content of the atmosphere. This band is important as it coincides with an important water absorption line, and by measuring close to this line, information on water vapour in the atmosphere can be gained. This information is used, in particular, for weather prediction and climate change modelling. The sensors on these satellites need to collect natural radiation at very low power levels which means that they are very sensitive and may be susceptible to out-of-band emissions from the 26 GHz band.

26 GHz uses

2.20 Potential future uses of the 26 GHz band are emerging and might include, amongst other things, mobile hotspots[14], Fixed Wireless Access (FWA) [15], mobile private networks (verticals), mobile on macro sites and integrated access and backhaul.

2.21 In the technical analysis we have conducted to inform our proposals in this consultation, we have based our studies on mobile hotspot and FWA deployments because we consider that these will provide results that encompass the range of future uses likely to be deployed in the 26 GHz band.

Measures to protect 24 GHz uses from out-of-band emissions from the 26 GHz band

2.22 The WRC-19 established initial and final limits on out-of-band emissions from stations in the 26 GHz band, with a transition date of 1 September 2027 to go from the initial to the final limits. In Europe, the transition date was brought forward to 1 January 2024[16] as the expectation was that mass market deployment would be likely be reached earlier than the transition date set by WRC-19.

2.23 We are required by UK law to ensure, in compliance with the relevant harmonised conditions, that future terrestrial systems capable of providing wireless broadband electronic communications in the 26 GHz band appropriately protect systems in adjacent bands, in particular the EESS (passive) and the RAS in the 24 GHz band.[17] In line with this requirement, we have considered whether, in addition to the harmonised limits for out-of-band emissions, further measures should apply.

[14] The hotspot use case is where the base station is serving terminal stations within close proximity and they tend to move around (mobile).
[15] The FWA use case is where that the base station has more directional antenna with a higher peak gain and generally located high above the rooftop. The terminal station at the other end is also fixed but generally below the rooftop.
[16] This change was introduced by Commission Implementing Decision (EU) 2020/590 of 24 April 2020 amending Decision (EU) 2019/784.and CEPT in ECC Decision (18)06 on the harmonised technical conditions for Mobile/Fixed Communications Networks (MFCN) in the band 24.25-27.5 GHz, as amended on 20 November 2020-https://docdb.cept.org/document/3361
[17] See Article 3(a) of the 26 GHz Decision.

Legal framework

2.24 Ofcom is responsible for authorising use of the radio spectrum. We permit the use of the radio spectrum either by granting wireless telegraphy licences under the Wireless Telegraphy Act 2006 (the "**WT Act**") or by making regulations exempting the use of particular equipment from the requirement to hold such a licence. In making the proposals for the additional measures set out in this document, we have taken account of the relevant legal framework, which is set out in Annex A1. This includes, in particular, Ofcom's statutory powers and duties, the harmonised limits on out-of-band emissions set out in the 26 GHz Decision and the framework under which we can impose conditions in spectrum licences.

Impact Assessment

2.25 Section 7 of the Communications Act 2003 (the "**Communications Act**") provides that where we are proposing to do anything for the purposes of or in connection with the carrying out of our functions, and it appears to us that the proposal is important, we are required to carry out and publish an assessment of the likely impact of implementing the proposal, or a statement setting out our reasons for thinking that it is unnecessary to carry out such an assessment. Where we publish such an assessment, stakeholders must have an opportunity to make representations to us about the proposal to which the assessment relates.

2.26 Impact assessments provide a valuable way of assessing different options for regulation and showing why the preferred option was chosen. They form part of best practice policymaking. As a matter of policy, Ofcom is committed to carrying out impact assessments in relation to the majority of our policy decisions. The analysis presented in this document as a whole constitutes our impact assessment, as defined in section 7 of the Communications Act.

Equality Impact Assessment

2.27 Section 149 of the Equality Act 2010 (the "**2010 Act**") imposes a duty on Ofcom, when carrying out its functions, to have due regard to the need to eliminate discrimination, harassment, victimisation and other prohibited conduct related to the following protected characteristics: age; disability; gender reassignment; marriage and civil partnership; pregnancy and maternity; race; religion or belief; sex and sexual orientation. The 2010 Act also requires Ofcom to have due regard to the need to advance equality of opportunity and foster good relations between persons who share specified protected characteristics and persons who do not.

2.28 Section 75 of the Northern Ireland Act 1998 (the "1998 Act") also imposes a duty on Ofcom, when carrying out its functions relating to Northern Ireland, to have due regard to the need to promote equality of opportunity and regard to the desirability of promoting good relations across a range of categories outlined in the 1998 Act. Ofcom's Revised

Northern Ireland Equality Scheme explains how we comply with our statutory duties under the 1998 Act.

2.29 To help us comply with our duties under the 2010 Act and the 1998 Act, we assess the impact of our proposals on persons sharing protected characteristics and in particular whether they may discriminate against such persons or impact on equality of opportunity or good relations.

2.30 We do not consider that our proposals have equality implications under the 2010 Act or the 1998 Act.

Future authorisation of the 26 GHz band

2.31 As indicated above, the 26 GHz band has been adopted as a pioneer 5G band in Europe. At WRC-19 the band was globally identified for IMT. We expect to consult on proposals for authorising access to the 26 GHz band for future wireless broadband services in Q1 of FY 22/23.

Next Steps

2.32 Stakeholders are invited to provide comments on the proposals set out in this document by 5pm on 24 February 2022. We expect to publish a statement in the second half of 2022.

Structure of this document

2.1 The remainder of this document is structured as follows:

a) Section 3 sets out how we have reached our proposals for additional measures to protect the Radio Astronomy Service in the UK.

b) Section 4 sets out how we have reached our proposals for additional measures protect the Earth Exploration Satellite Service (passive).

c) Section 5 summarises our proposals and next steps.

d) Annex 1 sets out the legal framework for our proposals.

e) Annex 2 contains our technical analysis.

3. Additional measures to protect the Radio Astronomy Service

Summary

3.1 As indicated in section 2, the harmonised conditions include certain limits on out-of-band emissions[18]. In this section, we have considered whether we should adopt additional measures to ensure the protection of Radio Astronomy Service use in the 24 GHz band.

3.2 In light of the analysis set out in this section and in Annex 2, we propose to implement exclusion zones, where no outdoor 26 GHz deployment will be permitted, around all 6 RAS sites as follows:

a) In 24.25 GHz-25.05 GHz: the deployment of any base station operating at these frequencies which is brought into use before 1 January 2024 would not be permitted within a distance of 4.5 km from the RAS site; for any base station which is brought into use after 1 January 2024, the relevant distance would be 2.5 km; and

b) In 25.05-27.5 GHz: the deployment of any base station operating at these frequencies which is brought into use before 1 January 2024 would not be permitted within a distance of 1.5 km from the RAS site; for any base station which is brought into use after 1 January 2024, the relevant distance would be 1 km.

3.3 Our provisional view is that exclusion zones or other additional measures are not necessary to protect RAS sites from indoor-only 26 GHz uses. We therefore propose to remove the 1 km exclusion zones around Cambridge and Jodrell Bank RAS sites from the current 26 GHz indoor shared access licence product.

Our approach to considering measures for RAS

3.4 The 24 GHz band is currently used for radio astronomy by the e-MERLIN network, which uses six radio astronomy telescopes at the locations shown in Figure 2. Our technical analysis has considered the potential impact of the use of 26 GHz on all these e-MERLIN RAS sites.

3.5 We have taken the following steps to determine the additional measures that may be needed to protect RAS use at 24 GHz:

a) We first set out our understanding of uses of 26 GHz spectrum and those we have assumed in our technical analysis.

[18]Initial limits: Maximum base station total radiated power of -33 dBW/200 MHz and maximum terminal station total radiated power of -29 dBW/200 MHz (these are limits on out-of-band emissions from 26 GHz in the 23.6-24 GHz band and apply to deployments until 1 January 2024)
Final limits for new deployments from 1 January 2024: Maximum base station total radiated power of -39 dBW/200 MHz, and maximum terminal station total radiated power of -35 dBW/200 MHz (these are limits on out-of-band emissions from 26 GHz in the 23.6-24 GHz band)

b) We then summarise the results of our technical analysis based on likely uses of 26 GHz spectrum to determine their potential impact on RAS.

c) We then propose measures we consider necessary to protect RAS sites using 24 GHz.

26 GHz Uses

3.6 As explained in section 2, 26 GHz spectrum can be used to provide a range of uses to consumers. We have based our studies on mobile hotspot and FWA type deployments because we consider that these will provide results that encompass the range of future uses likely to be deployed in the 26 GHz band.

Summary of the results of our technical analysis

3.7 These paragraphs provide a high-level summary of the results of our analysis. A detailed description of the analysis is provided in Annex A2.8 - A2.54.

e-MERLIN

3.8 Our analysis indicates that exclusion zones are necessary for outdoor base stations to protect each of the six e-MERLIN radioastronomy sites because any deployment of base stations within these zones is likely to cause undue interference to RAS. Within the impacted areas identified by our technical analysis, we considered whether it would be possible to coordinate 26 GHz deployments. Coordination zones can be useful to enable deployment within impacted areas when there is a reasonable chance that coordination could be successful. However, our technical analysis shows that any deployment within the impacted area is likely to cause undue interference and therefore successful coordination would be unlikely. As the resulting exclusion zone sizes do not extend to more than a few kilometres from the RAS site, we consider they are unlikely to restrict future 26 GHz uses disproportionately.

3.9 Our analysis indicates that identical exclusions zones are needed around each radio astronomy site. The exclusion zone sizes will depend on (a) the date when the relevant base station operating in the 26 GHz band is brought into use (i.e. before or after 1 January 2024), (b) the frequencies at which the base station is deployed, and (c) the type of deployment. Specifically, our analysis shows that the size of each exclusion zone around each site:

a) could reduce for base stations deployed from 1 January 2024, when the final more stringent limit on out-of-band emissions is in place;

b) could be smaller for base stations deployed in frequencies further away from the 24 GHz band; and

c) would need to be larger under an FWA deployment scenario compared with a mobile hotspot scenario.

3.10 Our analysis indicates that exclusion zones are not necessary at the six e-MERLIN sites for indoor 26 GHz use.

3.11 The size of the resulting exclusion zones from our analysis for each scenario is given in **Table 2** below.

Table 2: Exclusion zone distances for all sites in the e-MERLIN array for each scenario

Base Station Maximum Total Radiated Power (dBW/200 MHz)	First 800 MHz (24.25 – 25.05 GHz)			Above the first 800 MHz (25.05 – 27.5 GHz)		
	Outdoor		Indoor (m)	Outdoor		Indoor (m)
	Hotspot (m)	FWA (m)		Hotspot (m)	FWA (m)	
Initial Limit (-33)	600	4,200	0	160	1,100	0
Final Limit (-39)	360	2,200	0	0	600	0

Single dish

3.12 In theory, two of the radio astronomy sites included in the e-MERLIN network (the ones located in Jodrell Bank and Cambridge) could also potentially be used for taking single dish measurements in the 24 GHz band. However, such single dish measurements are currently not being made and we are not aware of any plans to take single dish measurements in the future.

3.13 The distances needed so that out-of-band emissions from outdoor 26 GHz deployments would not affect single dish measurements would extend to several tens of kilometres from these two sites and would reach areas of Manchester and Cambridge. For indoor-only 26 GHz deployments, the distances would be a few kilometres. See Annex A2.51 - A2.54 for details.

Our Proposals

Exclusion zones to protect the current use of the e-MERLIN network

Outdoor 26 GHz use

3.14 For reasons explained in Annex A2.49 – A2.50 and paragraphs 3.7-3.11 we propose to protect RAS use from the risk of undue interference from outdoor use of the 26 GHz band by applying an **exclusion zone** around the geographic location of each of the six e-MERLIN radioastronomy sites. We have rounded up the results from our technical analysis to the nearest 0.5 km to simplify implementation of these exclusion zones.

3.15 It is unclear which uses of 26 GHz will likely be deployed around these six RAS sites. We are therefore proposing to set the size of the exclusion zones based on the FWA deployment

scenario as this scenario leads to larger exclusion zones as shown in table 2 above. This should ensure effective protection to the RAS sites in all potential deployment scenarios.

3.16 Our proposals for protecting RAS use from outdoor 26 GHz use are as follows:

a) In 24.25 GHz-25.05 GHz: the deployment of any base station operating at these frequencies which is brought into use before 1 January 2024 would not be permitted within a distance of 4.5 km from the RAS site; for any base station which is brought into use after 1 January 2024, the relevant distance would be 2.5 km; and

b) In 25.05-27.5 GHz: the deployment of any base station operating at these frequencies which is brought into use before 1 January 2024 would not be permitted within a distance of 1.5 km from the RAS site; for any base station which is brought into use after 1 January 2024, the relevant distance would be 1 km.

3.17 We would implement these measures, subject to this consultation, when we authorise access to future[19] uses in the 26 GHz band.

3.18 We acknowledge that our proposals may restrict the use of the 26 GHz band around each e-MERLIN site. Since new applications of the 26 GHz band are still emerging, we cannot be certain of the extent to which 26 GHz deployments will be restricted in those areas in practice. However, the impact is likely to be small as the exclusion zones we propose do not intersect any major towns and cities. To the extent our proposals are unlikely to restrict deployment in the 26 GHz band in these areas, our view is that restricting deployment in the proposed restriction zones around e-MERLIN sites is proportionate in order to protect the valuable services they provide.

Indoor 26 GHz use

3.19 Our analysis shows that additional measures are not necessary to protect the six e-MERLIN sites from indoor 26 GHz use (see Annex A2.48). Therefore, we do not propose to include any additional measures for future indoor uses of the band.

Single dish

3.20 We are not proposing additional measures for single dish measurements. This is because no single dish measurements are currently being taken in the 24 GHz band and it remains unclear how important such measurement might be in the future. In relation to outdoor 26 GHz deployments, we have also taken into account the risk that any additional measures could disproportionately restrict future 26 GHz uses, given they would likely extend to several tens of kilometres.

Changes to shared access indoor-only 26 GHz licences

3.21 Shared access indoor-only 26 GHz licences are currently not available within 1 km of Jodrell Bank and Cambridge RAS sites. In line with the approach proposed above, we also propose

[19] We will continue to work with MOD to understand their current and future uses at 26 GHz and any measures needed to ensure the appropriate protection of the Radio Astronomy Service

to remove this deployment restriction on the basis that (i) single use measurements are not taken at these sites in the 24 GHz band and (ii) as discussed below (paragraphs 3.22-3.24), our analysis indicates that exclusion zones are not necessary to protect the six e-MERLIN sites from indoor use in the 26 GHz band.

3.22 There is currently one licence authorising indoor-only use of 26 GHz spectrum[20], which we have issued under our shared access framework[21]. This licence currently includes the following out-of-band emission limits:

a) Maximum base station total radiated power of -42 dBW/200 MHz within the 23.6-24 GHz frequency band and

b) Maximum terminal station total radiated power of -38 dBW/200 MHz within 23.6-24 GHz frequency band

3.23 We also intend to revise the current limits for out-of-band emissions set out in the 26 GHz indoor-only shared access licence product so that they would be in line with the current harmonised limits on out-of-band emissions. Specifically, the limits set out in the current licence product that apply within the 23.6-24 GHz band would be replaced as follows:

a) A total radiated power limit of -42 dBW/200 MHz on the emissions from base stations would be replaced with the initial total radiated power limit of -33dBW/200 MHz until 1 January 2024 and final total radiated power limit of -39 dBW/200 MHz from 1 January 2024; and

b) A total radiated power limit of -38 dBW/200 MHz limit on the emissions from terminal stations would be replaced with the initial total radiated power limit of -29dBW/200 MHz until 1 January 2024 and final total radiated power limit of -35 dBW/200 MHz from 1 January 2024.

3.24 We propose to take any implementation action following our statement.

Question 1

For future outdoor use of 26 GHz, do you agree that the proposed exclusion zones will provide appropriate protection to the 6 radio astronomy sites? If not please explain your reasons for this providing any supporting evidence.

Question 2

For indoor use of 26 GHz, do you agree that additional measures are not needed to protect radio astronomy sites and that we should remove the existing 1 km exclusion zone around Jodrell Bank and Cambridge from the current 26 GHz indoor-only shared access licence product? If not, please explain your reasons for this providing any supporting evidence.

[20] https://www.ofcom.org.uk/spectrum/information/spectrum-information-system-sis/spectrum-information-portal
[21] Shared access licensing: https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/shared-access

4. Additional measures to protect the Earth Exploration Satellite Service (passive)

Summary

4.1 As indicated in section 2, the harmonised conditions include certain limits on out-of-band emissions[22]. In this section, we have considered whether we should adopt additional measures to ensure the protection of the EESS (passive)[23] in the 24 GHz band, taking into account the aggregate impact of 26 GHz base station deployments within the EESS (passive) sensor's instantaneous field of view[24]

4.2 There is a risk that the number of base stations deployed in some larger UK cities could exceed the numbers assumed in the studies that led to the out-of-band emission limits agreed at WRC-19, and thus risk causing undue interference to the EESS (passive) sensors. Therefore, for the reasons set out below, we are proposing to limit the number of outdoor 26 GHz base stations (within any 300 km^2 area) (see paragraph 4.23) deployed in the lowest 800 MHz of the 26 GHz band (specifically from 24.25-25.05 GHz).

4.3 We are proposing that no additional measures are necessary to limit the number of outdoor 26 GHz base stations deployed in the remaining 2.45 GHz of the band from 25.05-27.5 GHz or for any 26 GHz indoor-only uses.

Our approach to considering additional measures

4.4 To understand whether any additional measures are needed, we have approached our analysis as follows:

a) We first set out our understanding of uses of 26 GHz spectrum and those we have assumed in our technical analysis and existing 24 GHz EESS (passive) uses that need protection.

b) We then set out the results of the technical analysis that we have conducted based on these uses to consider the extent to which the aggregate effect of deployments might impact EESS (passive) use, taking into account the harmonised limits on out-of-band emissions.

c) We then propose the additional measures which we consider necessary to ensure EESS (passive) use at 24 GHz would be protected from undue interference.

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[22] Initial limits: Maximum base station total radiated power of -33 dBW/200 MHz and maximum terminal station total radiated power of -29 dBW/200 MHz (these are limits on out-of-band emissions from 26 GHz in the 23.6-24 GHz band and apply to deployments until 1 January 2024)
Final limits for new deployments from 1 January 2024: Maximum base station total radiated power of -39 dBW/200 MHz, and maximum terminal station total radiated power of -35 dBW/200 MHz (these are limits on out-of-band emissions from 26 GHz in the 23.6-24 GHz band)

[23] See Article 3(a) of the 26 GHz Decision.

[24] The instantaneous field of view is the area of the Earth over which the sensor instantaneously takes measurements

26 GHz uses

4.5 As explained in section 2, 26 GHz spectrum can be used to provide a range of uses to consumers. We have based our studies on mobile hotspot and FWA type deployments because we consider that these will provide results that encompass the range of future uses likely to be deployed in the 26 GHz band.

EESS (passive)

4.6 There are a range of EESS (passive) sensors that operate in the 24 GHz band. The parameters and characteristics of these are given in Recommendations ITU-R RS.1861[25] and ITU-R RS.2017[26]. We have used the most sensitive sensor (F8) from the range of sensors listed in Recommendation ITU-R RS.1861[25] for our analysis. This is because this is the most sensitive sensor currently deployed and ensuring the protection of this sensor will ensure that all other sensors operating at 24 GHz are also protected.

4.7 The field of view of the F8 sensor, that is the area of the Earth over which the sensor instantaneously takes measurements, is 306km^2. We have rounded our considerations to an area of 300km^2 for ease of reference and therefore our technical analysis has considered deployment of 26 GHz base stations in an area of this size. Our proposals are based on this reference area.

Summary of our technical assessment

Our approach

4.8 Our analysis is based on mobile hotspot and FWA deployments scenarios for 26 GHz as explained in paragraph 4.5 and the potential impact of out-of-band emissions from these deployments on the F8 sensor. The detail of our analysis is given in Annex 2 A2.55-A2.86.

4.9 To ensure the appropriate protection of EESS (passive) we considered how to enable the maximum number of 26 GHz base stations deployed in an area of 300km^2 while enabling deployments at the harmonised limits on out-of-band emissions (both the initial and final limits).

4.10 The studies which led to the out-of-band emission limits agreed at WRC-19 were derived from the mobile hotspot deployment scenario. However, we consider that the out-of-band emissions towards the EESS (passive) satellites from hotspot base stations are the same as the emissions from other potential uses of 26 GHz such as mobile macro and FWA base stations, the calculations on the maximum number of base stations would be independent of the type of base station used. See Annex A2.77.

4.11 We are proposing to only limit the number of base stations deployed and not the terminal stations because these terminal stations operate at much lower power and their

[25] Recommendation ITU-R RS.1861-0: Typical technical and operational characteristics of Earth exploration-satellite service (passive) systems using allocations between 1.4 and 275 GHz.
[26] Recommendation ITU-R RS.2017-0: Performance and interference criteria for satellite passive remote sensing.

contribution to the aggregate interference towards the EESS (passive) satellites are negligible compared to the base stations.

4.12 The base stations we have assumed in our analysis have a single sector with a horizontal coverage angle of about 120° serving terminal stations within their boresight.

Our findings

4.13 As explained in Annex A2.58, out-of-band emissions from indoor base stations deployed in the 26 GHz band is unlikely to cause undue interference to EESS (passive). This is because of the significant propagation losses from the indoor systems as signals are attenuated by buildings and that the typical indoor base station is unlikely to point directly towards the main beam of the EESS (passive) satellite. Therefore, our assessment of additional measures to protect EESS (passive) only applies to outdoor uses of 26 GHz.

4.14 On the basis of our analysis for outdoor 26 GHz uses, we consider that for all channel sizes that could be used, there is a risk that the aggregate effect of a large number of base stations (above a certain number) deployed in the lowest 800 MHz (24.25-25.05) could cause undue interference to the use of EESS (passive) at 24 GHz. This means that there would be a maximum number of base stations in any 300km^2 area above which there is a risk that undue interference could be caused to the EESS (passive) service. The number of base stations will not be a simple fixed number as it needs to account for the number deployed at the initial and final limits and the different channel bandwidths that might be used as described below:

a) **Use of different channel sizes[27]:** The channel size will affect the aggregate interference threshold based on our assumptions on 5G out-of-band emission characteristics. More base stations can be deployed within wider channels and we have developed a formula (see Equation 1 below) to calculate this. For a more detailed explanation see Annex A2.69 – A2.72.

b) **Deployments at the initial and final limits**: the number of base stations deployed at the initial limit will affect the number of base stations that could be deployed at the final limit in any 300km^2 area. The higher the number of base stations deployed at the initial limit, the lower the number of base stations that can be deployed at the final limit.

Therefore, base stations operating at different out-of-band limits (i.e. initial and final limits) and different channel sizes will contribute differently to the aggregate out-of-band emissions seen by EESS (passive).

4.15 In order to allow flexible deployment of base stations while ensuring protection of EESS (passive), we have developed a formula that uses an aggregate interference threshold to

[27] This is the range of channels covered by 5G standards: 50 MHz, 100 MHz, 200 MHz and 400 MHz. The 800 MHz channel size is included for completeness.

calculate how many base stations can be deployed in a 300km^2 area in a given channel. The formula is as follows:

Equation 1

$$(\mathrm{P}_{Initial} \times NBS_{Initial}) + (\mathrm{P}_{Final} \times NBS_{Final}) \leq \text{Aggregate interference threshold (linear)}$$

where

$\mathrm{P}_{Initial}$:	average base station out-of-band emission level at Initial Limit:	$10^{-35/10}$ (W/200 MHz)
P_{Final}:	average base station out-of-band emission level at Final Limit:	$10^{-41/10}$ (W/200 MHz)
$NBS_{Initial}$:	number of base stations at Initial Limit	
NBS_{Final}:	number of base stations at Final Limit	

4.16 The aggregate interference threshold depends on the channel size and this is summarised in Table 3. Annex A2.69 – A2.72 provides further explanation on the formula and how these thresholds are derived.

Table 3: Aggregate interference threshold on the ground for different channel sizes

Channel Size (MHz)	Aggregate Interference threshold (dBW/200 MHz)
50	-15.20
100	-12.66
200	-10.54
400	-9.08
800	-8.44

4.17 To accommodate a mixture of channel sizes, Equation 1 above can be adjusted as described in Annex A2.84 – A2.86.

Effect of base station deployment limitations in the lowest 800 MHz of the 26 GHz band

4.18 In this section we summarise some examples we have considered to show the impact that the restrictions in the lowest 800 MHz outlined above would have on deployments in practice.

4.19 As shown in the Table 4 below, if all the base stations were deployed in a 200 MHz channel with the initial limit (i.e. -33 dBW/200 MHz), the maximum number of base stations within the 300 km^2 area would be 279. Alternatively, if all the base stations were deployed in a 200 MHz channel with the final limit (i.e. -39 dBW/200 MHz), the maximum number of base stations within the same area would be 1111. This is the number of base stations that would be allowed in each 200 MHz channel up to 25.05 GHz (the lowest 800 MHz of the 26

GHz frequency band) and it is based on the aggregate interference threshold calculated for this channel size. An example showing the maximum number of base stations that could be deployed in a 400 MHz channel is also provided. The threshold for different channel sizes are given in Table 3.

4.20 Please refer to the Technical Annex (Annex 2) for detailed information on how we have calculated these and for further examples with different combinations of channel sizes and number of base stations at initial and final limits.

Table 4: Examples on the maximum number of base stations for different scenarios

Scenario	Number of outdoor base stations deployed at initial limit of -33 dBW/200MHz	Number of outdoor base stations deployed at final limit of -39 dBW/200MHz	Area
Deployments possible in a 200 MHz channel	279	1	300km^2
	100	713	
	50	912	
	0	1111	
Deployments possible in a 400 MHz channel	390	3	
	100	1157	
	50	1356	
	0	1555	
Note: These are examples and these maximum numbers of base stations are interrelated and will vary depending on the number of base stations that are deployed at the different initial/final OOB emission limits. It applies to the lowest 800 MHz of the 26 GHz frequency band.			

Effect of out-of-band emissions from base stations deployed above 25.05GHz

4.21 Our analysis shows that the aggregate effect of out-of-band emissions from 26 GHz base stations deployed above 25.05 GHz is unlikely to cause undue interference to EESS (passive) use and therefore no additional measures are required. This is because, as illustrated in Figure A12, the out-of-band emissions from any base station decrease as frequency separation from the carrier increases. With over 1 GHz in frequency separation, out-of-band emissions from base stations deployed above 25.5 GHz will have decreased to a level where they will not significantly contributed to the overall aggregate interference. For a full description see Annex 2.

Our proposal

4.22 Our analysis shows that there is a risk that the aggregate effect of the out-of-band emissions from a large number of base stations (above a certain number) deployed in any 300 km^2 area in the lowest 800 MHz of the band of the 26 GHz band could cause undue interference to EESS (passive). To mitigate this risk, we are proposing to introduce a limit on the number of base stations that can be deployed in any 300 km^2 area in the lowest 800 MHz portion of the 26 GHz band. The calculation of the number of base stations will be

based on Equation 1 above and the approach set out in Annex 2 for different combinations and mixes of channel sizes and number of base stations at initial and final limits.

4.23 For the purposes of this proposal, we define a base station as comprising a single sector. For cases where a base station is deployed with more than one sector (3 sectors for example), the calculation would count each sector as separate base stations.

4.24 We do not consider it necessary to propose restrictions in the remainder of the 26 GHz band, that is from 25.05-27.5 GHz.

4.25 As we cannot be certain of the number of base stations that might be deployed in different areas of the country, we propose to implement this limit on the number of base stations that can be deployed in any 300 km^2 area on a UK wide basis. However, we consider that this measure it is unlikely to constrain the deployment of base stations in most areas (with the possible exception of a few larger cities). In areas that would be affected, our view is that this is necessary and proportionate in order to protect the valuable services provided by EESS (passive).

Applying this approach to future authorisations

4.26 As we have explained in this consultation, our proposal for outdoor uses would not apply to existing outdoor uses[28] but new wireless services at 26 GHz, including 5G mobile and other technologies that we are preparing[29] to authorise as part of our work to enable access to the 26 GHz band. When we make our proposals for these future uses, the approach to calculating the number of base stations that can be deployed in a 300 km^2 area that we are proposing in this consultation would be applied to the appropriate authorisation approach for the lowest 800 MHz of the 26 GHz band.

4.27 In summary, our proposals are:

a) to limit the number of 26 GHz outdoor base stations that can be deployed in the lowest 800 MHz of the 26 GHz band from 24.25-25.05 GHz in any 300km^2 area of the UK. This limitation will be based on the approach given in 4.15 - 4.17 above and A2.55 - A2.86. We would implement this measure, subject to this consultation, when we authorise future[30] access to 26 GHz. When we make decisions on future authorisations at 26 GHz, we will provide a specific process on how this approach can be implemented for specific authorisation proposals.

b) that no additional measures are necessary to limit the number of base stations that can be deployed in any area in the remaining 2.45 GHz portion of the 26 GHz band (i.e. above 25.05 GHz)

[28] Existing allocations between 24-26.5 GHz which would not be affected by the proposals in this consultation are: short range devices (21.6-27 GHz); Programme Making and Special Events (24.25-25 GHz); Fixed Links (24.5-26.5 GHz); Earth Stations of the Earth Exploration Satellite Service and Space Research Service (25.5-26.5 GHz); MOD use (26.5-27.5 GHz)
[29] We plan to consult on these proposals in Q1 FY 22/23
[30] We will continue to work with MOD to understand their current and future uses at 26 GHz and any measures needed to ensure the appropriate protection of the Earth Exploration Satellite Service (passive)

Question 3

Do you agree with our proposal to limit the number of 26 GHz base stations in 24.25-25.05 GHz to protect EESS (passive) use at 24 GHz? If not, please explain your reasons for this providing detailed supporting evidence.

5. Summary of proposals and next steps

5.1 This section summarises our proposals to adopt additional measures that will apply to 26 GHz base stations to ensure the appropriate protection of Radio Astronomy Service and Earth Exploration Satellite Service(passive) uses at 24 GHz.

26 GHz authorisations to which our proposals apply

5.2 Our proposals in this consultation apply to the following authorisations in the 24.25-27.5 GHz (26 GHz) band:

a) New[31] wireless services, including 5G mobile and other technologies that we are preparing to authorise as part of our work to enable access to the 26 GHz band and,

b) Indoor-only authorisations that we have enabled in part of the 26 GHz band.

The harmonised limits on out-of-band emissions

5.3 The measures which we are proposing in this consultation would be additional to the harmonised limits on out-of-band emissions set out in the 26 GHz Decision, which are shown in Table 5 below.

Table 5: Harmonised out-of-band emission limits

	Base station			Terminal station		
	Frequency range	**Maximum Total Radiated Power[32]**	**Measurement bandwidth**	**Frequency range**	**Maximum Total Radiated Power**	**Measurement bandwidth**
Initial limit applies to stations deployed before 1 January 2024	23.6-24 GHz	-33 dBW	200 MHz	23.6-24 GHz	-29 dBW	200 MHz
Final limit applies to stations deployed from 1 January 2024	23.6-24 GHz	-39 dBW	200 MHz	23.6-24 GHz	-35 dBW	200 MHz

[31] We will continue to work with MOD to understand their current and future uses at 26 GHz and any measures needed to ensure the appropriate protection of the Radio Astronomy Service and Earth Exploration Satellite Service (passive)

[32] Total radiated power (TRP) is a measure of how much power a composite antenna radiates. It equals the total conducted power input into the antenna array system less any losses in the antenna array system. TRP means the integral of the power transmitted in different directions over the entire radiation sphere as shown in the formula:
where P(θ,ϕ) is the power radiated by an antenna array system in direction (θ,ϕ) given by the formula:
$P(\vartheta,\varphi) = P_{Tx}g(\vartheta,\varphi)$
where P_{Tx} denotes the conducted power (measured in Watts), which is input into the array system, and g(θ,ϕ) denotes the array systems directional gain along the (θ, ϕ) direction.

Our proposals for additional measures

To protect Radio Astronomy Service use at 24 GHz

e-MERLIN sites

5.4 The sites that are covered by our proposal are the following Radio Astronomy sites:

a) Jodrell Bank (SJ 79650 70950)

b) Cambridge (TL 39400 54000)

c) Darnhall (SJ 64275 62265)

d) Defford (SO 90200 44700)

e) Knockin (SJ 32855 21880)

f) Pickmere (SJ 70404 76945)

Outdoor 26 GHz use

5.5 For outdoor 26 GHz use, we are proposing to apply an exclusion zone in which the deployment of base stations operating at 26 GHz would not be permitted. These exclusion zones would be around 6 radio astronomy sites in the UK to protect the e-MERLIN array sites as follows:

a) In 24.25 GHz-25.05 GHz: the deployment of any base station operating at these frequencies which is brought into use before 1 January 2024 would not be permitted within a distance of 4.5 km from the RAS site; for any base station which is brought into use after 1 January 2024, the relevant distance would be 2.5 km; and

b) In 25.05-27.5 GHz: the deployment of any base station operating at these frequencies which is brought into use before 1 January 2024 would not be permitted within a distance of 1.5 km from the RAS site; for any base station which is brought into use after 1 January 2024, the relevant distance would be 1 km.

Indoor-only 26 GHz use

5.6 We are not proposing any additional measures to protect the e-MERLIN array from future indoor deployments in the 26 GHz band. In line with this approach, we are proposing to remove the existing exclusion zones of 1 km zone around Jodrell Bank and Cambridge radio astronomy sites from the current 26 GHz indoor shared access licence product.

5.7 We intend to revise the current limits for out-of-band emissions set out in the 26 GHz indoor-only shared access licence product, so that they would be in line with the current harmonised limits on out-of-band emissions. Specifically, the limits set out in the current licence product that apply within the 23.6-24 GHz band would be replaced as follows:

a) A total radiated power limit of -42 dBW/200 MHz on the emissions from base stations would be replaced with the initial total radiated power limit of -33dBW/200 MHz until

1 January 2024 and final total radiated power limit of -39 dBW/200 MHz from 1 January 2024; and

b) A total radiated power limit of -38 dBW/200 MHz limit on the emissions from terminal stations would be replaced with the initial total radiated power limit of -29dBW/200 MHz until 1 January 2024 and final total radiated power limit of -35 dBW/200 MHz from 1 January 2024 .

5.8 We propose to take any implementation action, including varying any current shared access indoor-only 26 GHz licences, the relevant conditions in the shared access licence product for 26 GHz and related documents, following our statement.

To protect Earth Exploration Satellite Service (passive)

5.9 We propose:

a) to limit the number of 26 GHz outdoor base stations that can be deployed in the lowest 800 MHz of the 26 GHz band from 24.25-25.05 GHz in any 300km^2 area of the UK. The calculation of the number of base stations will be based on Equation 1 (see 4.15) and the approach set out in Annex 2 for different combinations and mixes of channel sizes and number of base stations at initial and final limits. For the purposes of this proposal, we define a base station as comprising a single sector. For cases where a base station is deployed with more than one sector (3 sectors for example), the calculation would count each sector as separate base stations. We would implement this measure, subject to this consultation, when we authorise future access to 26 GHz; and

b) that no additional measures are necessary to limit the number of base stations that can be deployed in any area in the remaining 2.45 GHz portion of the 26 GHz band (e.g. above 25.05 GHz).

Legal tests

5.10 We have considered whether the technical conditions which we are proposing would meet our statutory duties, including in particular the legal tests set out in section 9(7) of the Wireless Telegraphy Act 2006. Our provisional assessment is that our proposed conditions would be:

a) **objectively justified**, in that they are intended to ensure appropriate protection to the Radio astronomy service and the Earth exploration satellite service (passive) operating at 24 GHz (23.6-24 GHz) from the risk of undue interference from future systems operating in the 26 GHz band;

b) **not unduly discriminatory** against particular persons or against a particular description of persons in that they would apply to all new spectrum users[33] that would be authorised to operate in the relevant frequencies within the 26 GHz band;

[33] We will continue to work with MOD to understand their current and future uses at 26 GHz and any measures needed to ensure the appropriate protection of the Radio Astronomy Service and Earth Exploration Satellite Service (passive)

c) **proportionate** to what they are intended to achieve, in that the proposed technical restrictions would be the minimum necessary to protect Radio astronomy services and the Earth exploration satellite services from the risk of undue interference from future uses in the 26 GHz; and

d) **transparent** to what they are intended to achieve, in that our proposed conditions are clearly described and explained in this consultation document, and they would be clearly set out in the relevant licences.

Next Steps

5.11 Stakeholders are invited to provide their feedback on the proposals set out in this document. Ofcom will carefully consider the responses and if we decide to proceed with our proposals, we will publish a statement in the second half of 2022 setting out our decision and describing the actions needed to implement it.

A1. Legal framework

A1.1 Ofcom's statutory powers and duties in relation to spectrum management are set out primarily in the Communications Act 2003 (the **"2003 Act"**) and the Wireless Telegraphy Act 2006 (the **"WT Act"**).

Duties under the Communications Act 2003

A1.2 Our principal duties under the 2003 Act, when carrying out our functions and exercising our powers, are to further the interests of citizens and consumers, where appropriate by promoting competition. In doing so, we are also required (among other things) to secure the optimal use of spectrum and the availability throughout the United Kingdom of a wide range of electronic communications services.

A1.3 We must also have regard to: (i) the desirability of promoting competition in relevant markets; (ii) the desirability of encouraging investment and innovation in relevant markets; (iii) the desirability of ensuring the security and availability of public electronic communications networks and services; (iv) the different needs and interests, so far as the use of the electro-magnetic spectrum for wireless telegraphy is concerned, of all persons who may wish to make use of it; and (v) the different interests of persons in the different parts of the United Kingdom, of the different ethnic communities within the United Kingdom and of persons living in rural and in urban areas.

A1.4 In performing our duties, we are required under section 3(3) of the 2003 Act to have regard in all cases to the principles under which regulatory activities should be transparent, accountable, proportionate, consistent and targeted only at cases in which action is needed.

A1.5 In carrying out certain regulatory functions, including Ofcom's spectrum management functions, section 4 of the 2003 Act requires Ofcom to act in accordance with the following requirements: a) to promote competition in communications markets; b) to promote the interests of all members of the public in the United Kingdom; c) to act in a manner which, so far as practicable, is technology neutral[34]; d) to encourage, to the extent Ofcom considers it appropriate, the provision of network access and service interoperability for the purpose set out in s.4(8)[35]; e) to encourage such compliance with certain international standards as is necessary for the purposes set out in s.4(9)[36]; and f) to promote connectivity and access to very high capacity networks by members of the public and businesses in the United Kingdom.

[34] According to s.4(6A) of the 2003 Act, this requirement does not apply to the imposition, in relation to a wireless telegraphy licence, of a limitation of a kind falling within section 9ZA(1) of the WT Act; or (b) the review, variation or removal of such a limitation.
[35] The purpose of securing: (i) efficiency and sustainable competition, (ii) efficient investment and innovation, and (iii) the maximum benefit for the customers of communications providers and of persons who make associated facilities available.
[36] For facilitating service interoperability, end-to-end connectivity, the changing by end-users of their communications provider, the retention by end-users of their telephone numbers after a change of communications provider; and securing freedom of choice for the customers of communications providers.

Duties under the Wireless Telegraphy Act 2006

A1.6 Additionally, in carrying out our spectrum functions we have a duty under section 3 of the WT Act to have regard in particular to: (i) the extent to which the spectrum is available for use, or further use, for wireless telegraphy; (ii) the demand for use of that spectrum for wireless telegraphy; and (iii) the demand that is likely to arise in future for such use.

A1.7 We also have a duty to have regard to the desirability of promoting: (i) the efficient management and use of the spectrum for wireless telegraphy; (ii) the economic and other benefits that may arise from the use of wireless telegraphy; (iii) the development of innovative services; and (iv) competition in the provision of electronic communications services.

Harmonised technical conditions

A1.8 Certain European decisions continue to have effect in domestic UK law, following Brexit, by virtue of section 3 of The European Union (Withdrawal) Act 2018. These include, in particular, the Implementing Decision issued by the European Commission in 2019 to open up the 26 GHz band for wireless broadband under harmonised technical conditions, which it then amended in 2020 (the **"26GHz Decision"**).[37]

A1.9 The 26GHz Decision harmonises the essential technical conditions for the availability and efficient use of the 24.25-27.5 GHz frequency band (the "**26 GHz band**") in the European Union for terrestrial systems capable of providing wireless broadband electronic communications services (Art. 1) and requires the UK (and the EU Member States) to designate and make available on a non-exclusive basis that frequency band for such systems, in accordance with the essential technical conditions in the Annex (Art. 2).

A1.10 It also contains provisions about the co-existence between terrestrial systems for wireless broadband and other spectrum users. These provisions are particularly relevant to this consultation, and they provide the basis for our proposals. In particular, the 26GHz Decision provides that:

a) it should be analysed at national level whether it is necessary to impose additional technical conditions to ensure appropriate co-existence with other services in the band (Art. 2);

b) terrestrial systems for wireless broadband must appropriately protect other spectrum users operating in the same band or adjacent bands, including certain earth exploration satellite services, radio astronomy services, space research services and satellite systems (Art. 3);

c) fixed links may be allowed to continue to operate within the band, if the terrestrial systems for wireless broadband can co-exist with them through managed shared spectrum use (Art. 4);

[37] An unofficial consolidated version of Decision 2019/784, as amended by Decision 2020/590, is available here

d) the number and locations of new earth stations must be determined so as not to impose disproportionate constraints on terrestrial systems for wireless broadband. Subject to market demand, the continued deployment of earth stations must be made possible for certain uses within the 26GHz band (Art. 5); and

e) the progress on co-existence should be monitored, and the findings reported to the European Commission to allow for a timely review of the 26GHz Decision (Art. 7).

A1.11 Cross-border coordination agreements should be facilitated to enable the operation of terrestrial systems for wireless broadband (Art. 6).

Ofcom's licensing framework

A1.12 Ofcom is responsible for authorising use of the radio spectrum. We permit the use of the radio spectrum either by granting wireless telegraphy licences under the WT Act or by making regulations exempting the use of particular equipment from the requirement to hold such a licence. It is unlawful and an offence to install or use wireless telegraphy apparatus without holding a licence granted by Ofcom, unless the use of such equipment is exempted.[38]

A1.13 This document is a consultation on technical licence conditions to be included in licences authorising use of the 26GHz band. Below we explain the legal framework under which we can impose conditions in spectrum licences.

Licence conditions

A1.14 A wireless telegraphy licence may be granted subject to such terms, provisions and limitations as Ofcom think fit (WT Act, s. 9(1)). However, this power is subject to certain constraints. In particular:

a) the terms, provisions and limitations of a spectrum licence must not duplicate the obligations already imposed on the licensee by the general conditions set by Ofcom under section 45 of the Communications Act 2003 (WT Act, s. 9(6));[39] and

b) Ofcom may only impose terms, provisions and limitations which are: a) objectively justified in relation to the network and services to which they relate; b) not unduly discriminatory; c) proportionate to what they are intended to achieve; and d) transparent in relation to what they are intended to achieve (WT Act, s. 9(7)).

A1.15 Section 9(4) of the WT Act sets out a non-exhaustive list of the terms, provisions and limitations that Ofcom may impose.

A1.16 Examples of the types of conditions we may impose in spectrum licences under s9 WT Act include:

a) limitations as to the position and nature of a station (s.9(2)(a));

[38] Section 8 of the WT Act.
[39] The "General Conditions of Entitlement", which are available here.

b) limitations as to the apparatus that may be installed or used (s.9(3)); and

c) terms, provisions and limitations as to strength or type of signal, as to times of use and as to the sharing of frequencies the strength or type of signal (s.9(4)(a).

A2. Technical Analysis

A2.1 This annex explains the technical analysis we have undertaken in order to assess potential interference from 5G services operating in the 26 GHz frequency band (i.e. 24.25-27.5 GHz) to the radio astronomy service (RAS) and the earth exploration satellite service (passive) (EESS (passive)), which operate in the 24 GHz frequency band (i.e. 23.6 – 24 GHz).

A2.2 It first sets out how we have reached our proposals for defining an exclusion zone around each of the radio astronomy stations, which we have derived from our assessment of the area which is likely to be impacted by the out-of-band (OOB) emissions from 5G deployments in the 26 GHz band. From A2.55 it then explains how we have calculated our proposed limit on the number of base stations to protect the EESS (passive) service.

A2.3 We have considered 5G services deployed indoors and outdoors separately in our technical analysis. The 5G outdoor characteristics and simulation parameters are based on the ITU-R document[40] used for the sharing and compatibility studies leading to WRC-19.

A2.4 The outdoor scenario we have considered is based on two different deployment models:

a) the hotspot deployment model, where users' mobile terminals are near the base station, and the base station provides service within a ±60° horizontal coverage angle using a beamforming antenna. This is the main baseline deployment model used in the ITU-R sharing studies.

b) the fixed wireless access (FWA) deployment model where a beamforming antenna is used which has a higher peak gain and is more directional than the hotspot deployment, also with the same ±60° horizontal coverage angle as the hotspot. This deployment model is based on some of the early millimetre wave frequency band field trials and is described in more detail later in this annex.

A2.5 The indoor scenario we have considered is based on the same characteristics and simulation parameters as we used for our 26 GHz indoor shared access licence framework[41]. The analysis assumed a deployment of three ceiling-mounted base stations evenly spaced in an 1,800 m^2 floor area.

5G out-of-band (OOB) emission characteristics

A2.6 The OOB emissions from 5G equipment decrease as we move further away in frequency beyond its operating frequency, which means that the 5G channels higher up in the 26 GHz frequency band will emit a lower level of emissions into the adjacent services below 24 GHz (i.e. EESS (passive) and RAS).

A2.7 Due to the early stage of 26 GHz base station development, we have only seen a limited set of measurements of the OOB emissions provided by different vendors. These show some

[40] ITU-R R15 Annex 1 to Task Group 5/1 the Chairman's Report document TG 5-1/478: System Parameters and Propagation Models to be used in Sharing and Compatibility Studies.
[41] Ofcom shared access licenses framework at https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/shared-access

variation in OOB emission characteristics of 5G base stations operating in the millimetre wave frequency band. Some of these are based on 28 GHz systems which were configured to operate at full power and maximum data transmission so that they maximally occupy the channel for the purpose of the measurements; some are prototypes, and some have not considered the stringent OOB emission limit requirements defined at WRC-19. Therefore, it is difficult to draw definitive conclusions from these measurements, and we have made some assumptions, using our technical judgement, which we have explained further in this annex.

Coexistence analysis with RAS operating at 24 GHz

A2.8 There are 6 radio astronomy stations in the UK (Cambridge, Darnhall, Defford, Jodrell Bank, Knockin and Pickmere) which operate in the 24 GHz frequency band. These radio astronomy stations operate together as the e-MERLIN[10] network. It is important that these stations are protected from unwanted emissions for the reasons described in section 2.

A2.9 The outcome of WRC-19 did not include any specific technical conditions for protection of radio astronomy from 5G within a national territory. However, the 26 GHz Decision requires each country to ensure, in compliance with the relevant harmonised conditions, that the future terrestrial systems in the 26 GHz band appropriately protect systems in adjacent bands, in particular in the Earth Exploration Satellite Service (passive) and in the Radio Astronomy Service in the 24 GHz frequency band.

A2.10 We have modelled OOB emissions from 5G base stations operating in the 26 GHz frequency band into each of the radio astronomy stations, considering the local terrain and the specific parameters of these stations. We have not modelled terminals, because 5G base stations operate at much higher power than mobile terminals and base stations are the dominant interferer even in the OOB domain. The mobile terminals will be operating close to their connected base station and will cause a significantly lower level of OOB interference due to the operation of the device and partial shielding from the user. Furthermore, mobile terminals will not transmit when they are outside the coverage of a base station. Fixed (FWA) terminal stations could potentially have higher gain than typical mobile terminals, but that would be directed towards the base station and away from the radio astronomy station (unless they are further from the radio astronomy station than the base station is). Therefore, we consider that studying the interference from base stations only is sufficient for our analysis.

Methodology to calculate the impact area around the radio astronomy station

A2.11 The 26 GHz OOB emissions could cause interference to the 24 GHz radio astronomy service, but these radio astronomy stations can be protected by defining an area around them in which we can then impose measures to protect them. We refer to this area as the ‘impact area’. We have calculated the impact area in relation to three types of 5G use case: hotspot, FWA and indoor.

A2.12 The impact distance in each direction is dependent on the terrain around the radio astronomy station because terrain along the signal path influences how much the signal decreases along that path. In order to define the impact area, we have calculated the impact distance at every azimuth direction around the radio astronomy station.

A2.13 To calculate the impact area from each RAS we have used the OOB emission limits from 26 GHz 5G systems that were agreed during WRC-19 and the specific protection level for RAS in the UK. We have then considered what additional measures are necessary to protect RAS from OOB emissions from any 5G base stations deployed inside this impact area. 5G base stations deployed outside this impact area are unlikely to cause interference to RAS, and it is therefore unnecessary to consider imposing additional constraints on them.

A2.14 The OOB emission limits defined at WRC-19 and the protection criteria of the radio astronomy service are based on a different reference bandwidth, therefore we have calculated the amount of OOB emissions that will appear within the RAS bandwidth when determining the impact distance. In order to ensure that we have captured all potential base station locations that could cause interference to the RAS, we have calculated the impact distance with the boresight of the 5G base station antenna panel pointing directly at the radio astronomy station.

A2.15 We calculate the impact distance by first determining the signal propagation loss that would be needed to make the OOB emissions from the base station drop below the protection criterion at the radio astronomy station. Then we use the propagation model in ITU-R Recommendation P.452-16[42] with the local terrain profile around the radio astronomy station to convert the signal propagation loss into a separation distance. The terrain profile that we use has a resolution of 40m to capture the propagation characteristics and clutter along the path.

A2.16 We have refined our indoor methodology from our 26 GHz indoor shared access framework[43], in that we have considered the 26 GHz base station antenna gain and the building entry loss distribution (i.e. the degradation of signal due to penetration through the building) separately, in order to take a more cautious approach to our analysis.

Modelling of the radio astronomy stations

A2.17 Table A1 sets out the location and antenna height of the individual radio astronomy stations that we have considered.

Table A1: Location and antenna height of the RAS stations

No	Ordinance Survey National Grid Reference	Observatory	Antenna Height (m)	Easting	Northing
1	TL 39400 54000	Cambridge (CA)	32	539400	254000
2	SJ 64275 62265	Darnhall (DA)	25	364275	362265

[42] ITU-R Recommendation P.452-16: Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz

[43] Ofcom shared access licenses framework at https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/shared-access

3	SO 90200 44700	Defford (DE)	25	390200	244700
4	SJ 79650 70950	Jodrell Bank (JB) Mark II telescope	20	379650	370950
5	SJ 32855 21880	Knockin (KN)	25	332855	321880
6	SJ 70404 76945	Pickmere (PI)	25	370404	376945

A2.18 The antenna gain of the radio astronomy station towards the horizon is assumed to be 0 dBi, which is consistent with Recommendation ITU-R RA.769-2[44] on protection criteria for radio astronomical measurements and the studies that were done in preparation for WRC-19.

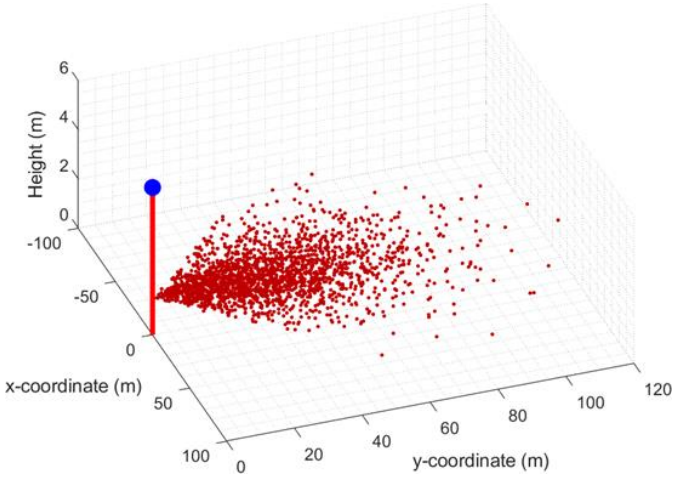
A2.19 We have also taken account of technical parameters relevant to the protection criteria for the e-MERLIN network, for example, local terrain.

A2.20 The e-MERLIN protection criteria (-168 dBW/250 kHz) is unique to the UK's network and has been agreed with the UK's Science and Technology Facilities Council.

Modelling outdoor 5G Hotspot deployment

A2.21 The 5G hotspot deployment scenario was the main 26 GHz use-case studied for WRC-19, and our analysis follows the baseline parameters outlined in the ITU's 5G parameters document[45] and the guidance on modelling the distribution of mobile terminals in the ITU document on "System Parameters and Propagation Models to be used in Sharing and Compatibility Studies"[40]. We have modelled a base station with an active antenna array size of 8x8 (i.e. 64 transmitting antenna elements) at 6m above ground, serving mobile terminals at 1.5m above ground. The mobile terminals are distributed within a ±60° horizontal coverage angle from the boresight of the base station. The base station and the distribution of the mobile terminals are shown in Figure A1

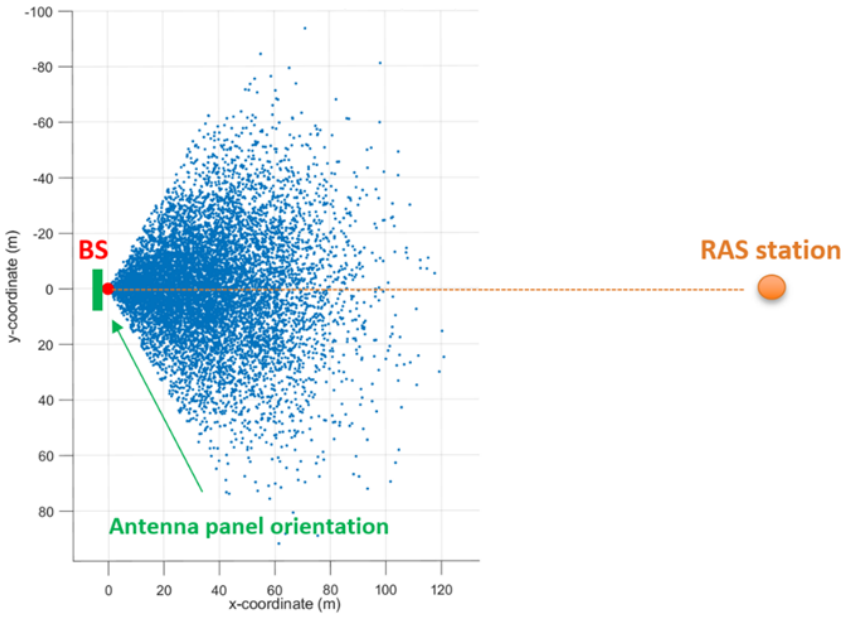
Figure A1: The distribution of mobile terminals in relation to the hotspot base station



[44] Recommendation ITU-R RA.769-2: Protection criteria used for radio astronomical measurements.
[45] The parameters for 5G is found in attachment 2 of ITU-R R15 document TG 5-1/36: Characteristics of Terrestrial IMT Systems for Frequency Sharing/Interference Analyses in the Frequency Range Between 24.25 and 86 GHz.

A2.22 For the analysis, we have assumed the base station horizontal antenna boresight is in the direction of the radio astronomy station as shown in Figure A2, in order to approximate a single worst-case scenario when defining the impact distance.

Figure A2: The relation between the base station, mobile terminals and the radio astronomy station



A2.23 For this adjacent frequency band analysis, we have used the 5G beamforming antenna pattern generated from the model in Recommendation ITU-R M.2101[46] with an effective antenna element spacing to wavelength ratio (d/λ) of 0.46. This adjustment of d/λ from the usual in-band value of 0.5[47] is to account for the different physical property of the antenna in the adjacent frequency band. We have also adjusted the antenna gain that is predicted by the model in this Recommendation to ensure that the integration of the predicted gain in all directions is equal to 1. While the antenna model correctly predicts relative gain in every direction around the antenna, a limitation of the formula is that the integration of the predicted gain in all directions does not always equal 1 (which would not be correct because it would imply that the energy that comes out of the antenna is not the same as the energy put into it). This adjustment is known as normalisation. These adjustments are in line with the guidance provided in the ITU document[40] on System Parameters and Propagation Models used for sharing and compatibility analysis in the preparation for WRC-19.

A2.24 The hotspot deployment model assumes that there is a concentration of mobile terminals close to the base station and moving within the ±60° base station horizontal coverage sector.

[46] Recommendation ITU-R M.2101-0: Modelling and simulation of IMT networks and systems for use in sharing and compatibility studies.
[47] The antenna parameter d/λ given as 0.5 is used for sharing studies in the same frequency band.

A2.25 In the direction of the horizon, i.e. where the radio astronomy site is located, we have taken the average base station antenna gain in our study because of the assumption of an averaging effect arising from the base station beamforming to various mobile terminals that are moving around the coverage area and the nature of the mobile transmission. This average antenna gain is calculated to be 10 dBi.

Modelling outdoor 5G Fixed Wireless Access (FWA) deployment

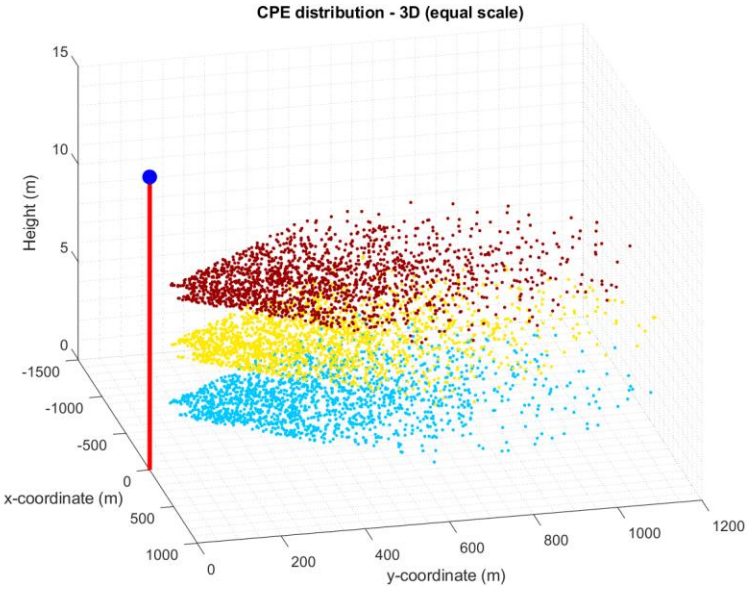
A2.26 We have also studied the impact of fixed wireless access (FWA) on the RAS. The key difference in this deployment model is that the base station antenna is more directional with a higher peak gain and located higher. In addition, the receive terminal is fixed rather than mobile. Fixed terminal stations could potentially have higher gain than typical mobile terminals, but that would be directed towards the base station and away from the radio astronomy station (unless they are further from the radio astronomy station than the base station is).

A2.27 To model the FWA deployment we modified some of the parameters we had used in the hotspot deployment scenario based on some of the early field trials of FWA in the millimetre wave frequency band, and in such deployments, the terminal station (i.e. consumer premises equipment, CPE) are modelled at different heights. The main parameters and assumptions that are modified from the hotspot deployment are shown in Table A2 and the deployment model is shown in Figure A3.

Table A2: Outdoor 5G FWA deployment parameters

Parameter	Value
Base station antenna height	15 m
Base station antenna size configuration	16x16 (256 antenna elements)
Base station antenna mechanical down-tilt	2°
Terminal station (CPE) height	Uniformly distributed at 3m, 6m and 9m above ground.
Terminal station (CPE) location with respect to the FWA base station	Uniformly distributed within ±60° horizontally from the boresight of the base station, and at a distance that is Rayleigh distributed between 100 m and 1.2 km (Rayleigh distribution with sigma, σ = 400).

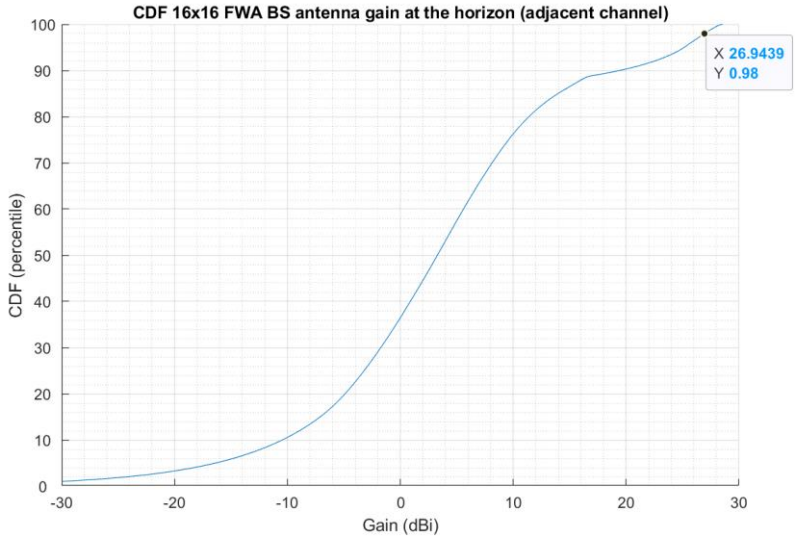
Figure A3: The distribution of CPE in relation to the FWA base station



A2.28 As with the hotspot deployment model, the beamforming antenna pattern we have used follows Recommendation ITU-R M.2101 with the antenna element spacing to wavelength ratio (d/λ) adjusted to 0.46, and normalisation of the antenna pattern gain applied. Also, the base station horizontal antenna boresight is in the direction of the radio astronomy station.

A2.29 The cumulative distribution function (CDF) of the horizontal antenna gain distribution from the Monte Carlo simulation of the deployment setup illustrated in Figure A3 towards the radio astronomy station is shown in Figure A4.

Figure A4: The CDF of the FWA 5G base station antenna gain



A2.30 We have taken the 98th percentile of the base station antenna gain CDF (27 dBi) for our analysis to reflect the FWA usage, i.e. the base station will beamform to individual fixed terminal stations at different instances but the duration of each instance is longer than it

was under the hotspot model for mobile terminals. This is 2 dB less than the peak gain of 29 dBi from the antenna model.

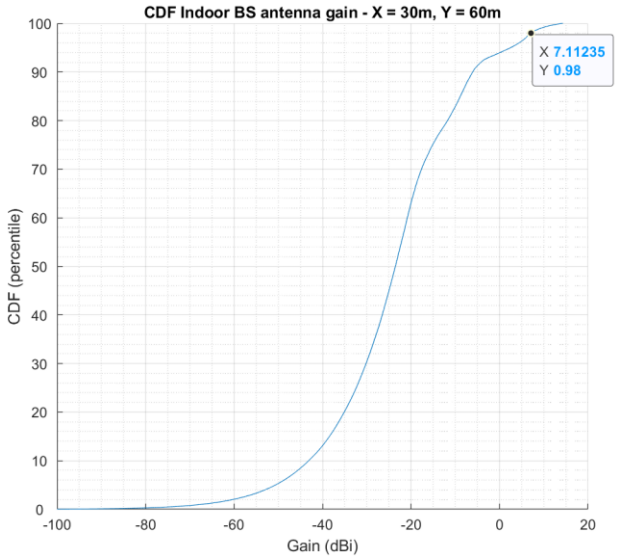
Modelling indoor 5G deployment

A2.31 We have used the same characteristics and simulation parameters for the indoor deployment model as we used for our 26 GHz indoor shared access licence framework[43] but we have refined the analysis as described in A2.16. The analysis assumed a deployment of three ceiling-mounted base stations evenly spaced in an 1,800 m^2 floor area.

A2.32 We have modelled indoor mobile terminals at 1.5m above a 3m standard floor height. These terminals are uniformly distributed across the floor of the building up to 1m from the wall and beamform to their nearest base station less than 15m away. Due to this proximity the indoor mobile terminals will transmit well below their maximum power for most of the time, and our modelling assumes that the OOB emissions from these terminals will therefore be significantly lower than the base stations. Therefore, we have not considered mobile terminals in our analysis.

A2.33 We have evaluated the base station antenna gain in all directions around the building towards the horizon in a Monte Carlo simulation with uniformly distributed indoor mobile terminals. The cumulative distribution function (CDF) of the indoor 5G base station antenna gain from the Monte Carlo simulation is shown in Figure A5.

Figure A5: The CDF of the indoor 5G base station antenna gain

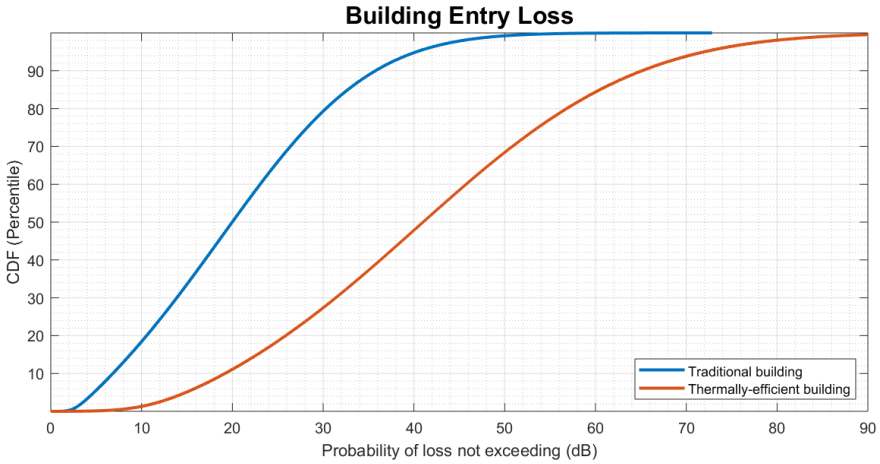


A2.34 We are considering the base station antenna gain point at the 98th percentile of the CDF to capture near worst setup condition for the analysis. This antenna gain is about 7 dBi.

Building penetration loss

A2.35 For the indoor analysis, we have used Recommendation ITU-R P.2109-1[48] for the building penetration loss and the CDF of this loss is shown in Figure A6. The recommendation defines the loss in two categories - the 'traditional' and 'thermally-efficient' building, and at the 50th percentile the 'thermally-efficient' buildings will have about 21 dB more loss than 'traditional' buildings.

Figure A6: Building entry loss for both 'traditional' and 'thermally-efficient' building



A2.36 We have been conservative in our approach on the building entry loss and only considered the CDF of the 'traditional' buildings. This is because we cannot be sure of the types of buildings close to the radio astronomy stations and we want to ensure we require adequate protection regardless of the type of building.

A2.37 The 'traditional' building entry loss considered in our analysis is at the 30th percentile, which is more likely for situations where the base station has some light obstacles in the way and this percentile equates to 14 dB of loss. Although the base station antennas are directional, we expect some reflections inside the buildings.

5G OOB Emissions Assumption for the RAS analysis

A2.38 We have defined impact areas in the following way:

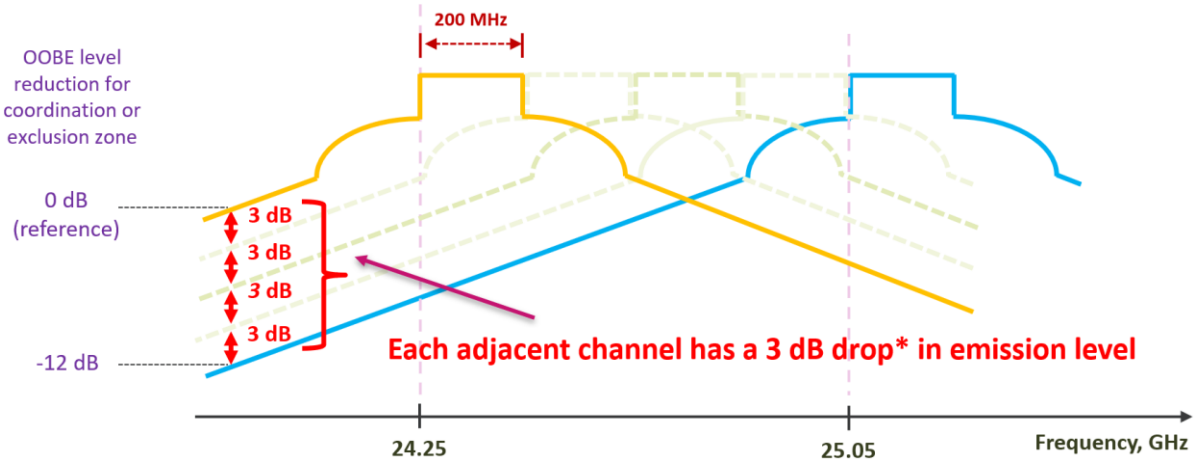
- For all channels within the lowest 800 MHz, we calculated the impact areas using the OOB emission limits from the 26 GHz Decision.
- For all channels above the lowest 800 MHz, we applied a flat 12 dB reduction below the 26 GHz Decision OOB emission limits, i.e. −45dBW/200 MHz for equipment installed before 1 January 2024 and −51dBW/200 MHz for equipment installed after that date, when we calculated the impact areas.

A2.39 We derived the 12dB reduction for base stations operating on frequencies above the lowest 800 MHz taking account of measurements provided by vendors, which indicate 3 dB drop in OOB emissions for each additional 200 MHz frequency separation as illustrated in Figure A7. On the basis that the radio astronomy calculations apply to emissions from a

[48] Recommendation ITU-R P.2109-1: Prediction of building entry loss

single base station, we did not assume any further reductions in OOB emissions due to lower network loading or vendor implementation margins.

Figure A7: 5G OOB emission assumption for the RAS analysis



Note: *We assume a 3 dB drop in emission level for every 200 MHz to calculate OOB emission reduction for the first channel above 25.05 MHz.

Result of the impact area around RAS for outdoor 5G hotspot deployment

A2.40 We have considered both the initial OOB emissions limit of -33 dBW/200 MHz and the final limit of -39 dBW/200 MHz. As shown in the results below, the size of the impact area is larger for the initial limit than the final limit.

The impact area due to 5G hotspot in the lowest 800 MHz (i.e. 24.25 – 25.05 GHz)

A2.41 The impact area is shown in Figure A8 and the maximum impact distance is provided in Table A3

Figure A8: Impact area of outdoor 5G hotspot in the lowest 800 MHz

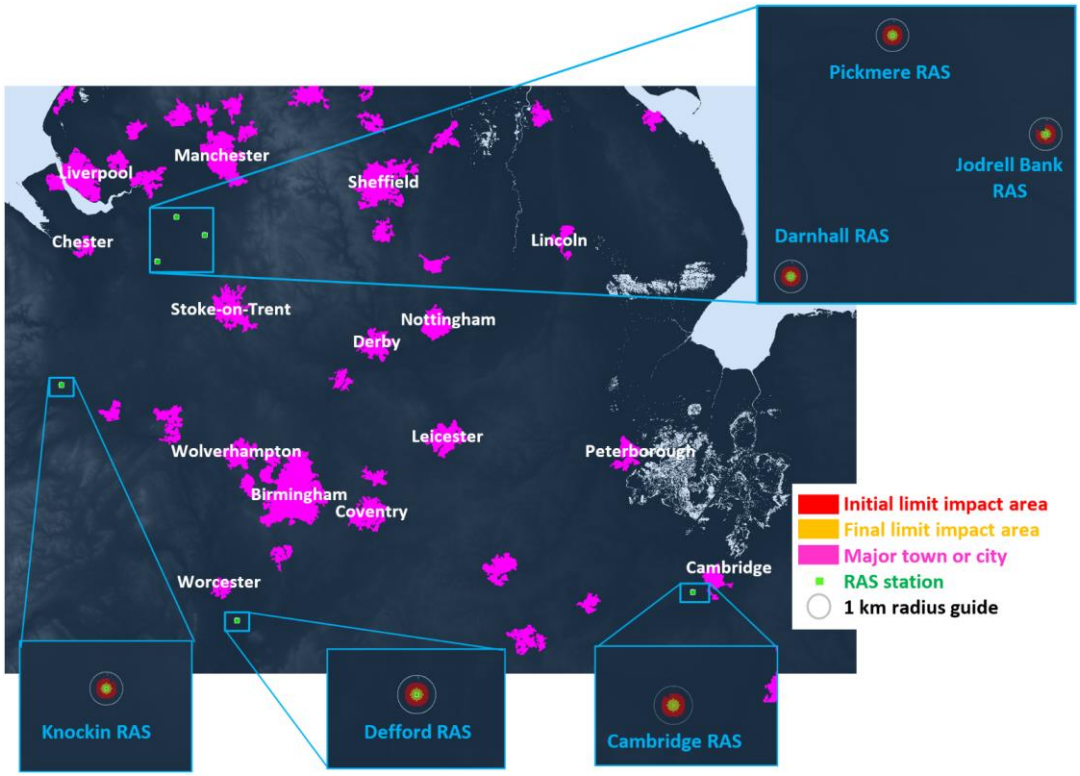


Table A3: The maximum impact distance for the outdoor 5G hotspot in the lowest 800 MHz of the 26 GHz band

Outdoor 5G base station OOB emission limit (dBW/200 MHz)	Maximum impact distance (m)
-33	600
-39	360

The impact area due to 5G hotspot above the lowest 800 MHz (i.e. 25.05 – 27.5 GHz)

A2.42 The impact area is shown in Figure A9 (this figure is taken from the output of the modelling tool – the pixelation in the figure is due to the distance being near the limit of resolution of the tool) and the maximum impact distance is provided in Table A4

Figure A9: Impact area of outdoor 5G hotspot above the lowest 800 MHz

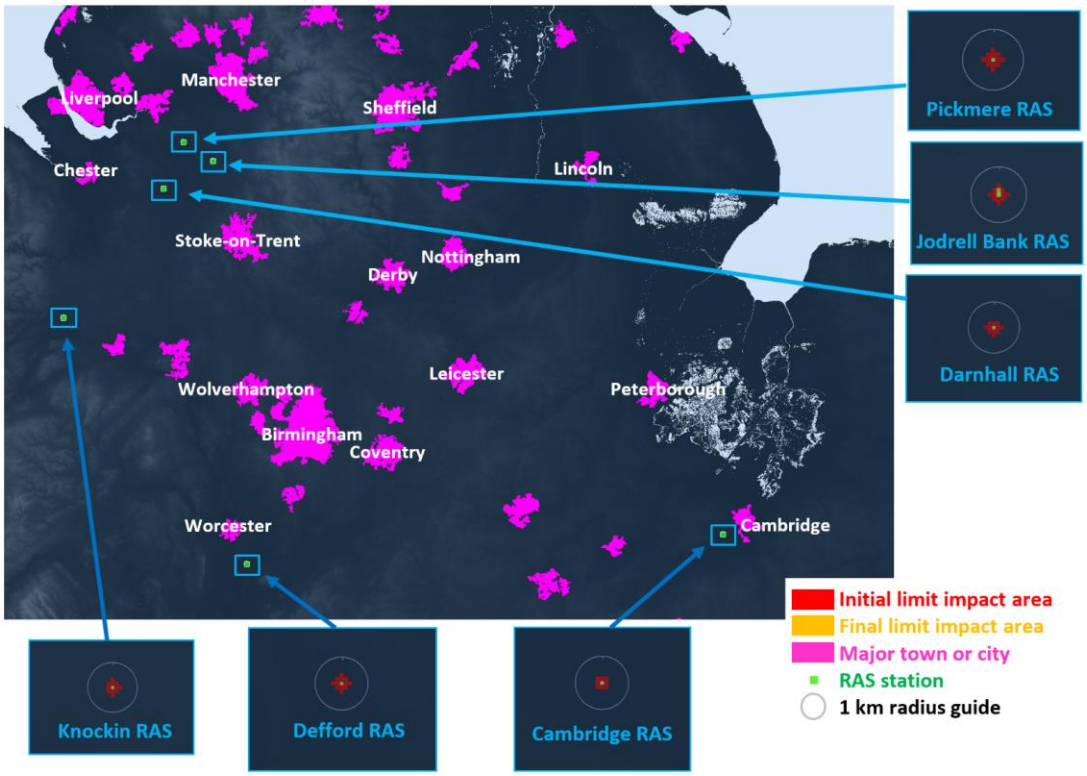


Table A4: The maximum impact distance for the outdoor 5G hotspot above the lowest 800 MHz

Outdoor 5G BS OOBE limit (dBW/200 MHz)	Maximum impact distance (m)
-33	160
-39	0

Result of the impact area around RAS for outdoor 5G FWA deployment

A2.43 The impact area around each radio astronomy station is slightly larger than the hotspot scenario and it is nearly circular in shape. As the maximum impact distance is relatively small for an FWA service, we consider it appropriate to define this as an exclusion zone – circular in shape with the radius set to this distance. In addition, we do not expect FWA to transmit across the radio astronomy site to its intended consumer premises equipment ("**CPE**").

The impact area due to 5G FWA in the lowest 800 MHz (i.e. 24.25 – 25.05 GHz)

A2.44 The impact area is shown in Figure A10 and the maximum impact distance is provided in Table A5.

Figure A10: Impact area of outdoor 5G FWA in the lowest 800 MHz

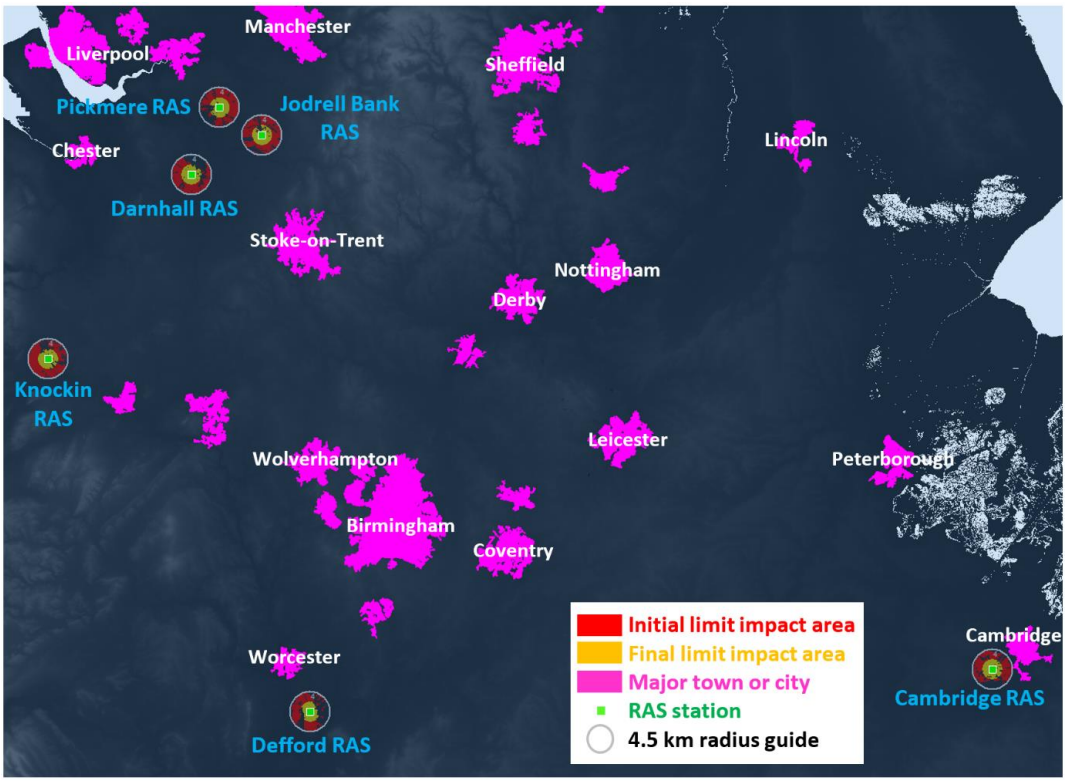


Table A5: The maximum impact distance for the outdoor 5G FWA in the lowest 800 MHz

Outdoor 5G base station OOB emission limit (dBW/200 MHz)	Maximum impact distance (m)
-33	4,200
-39	2,200

A2.45 The result in Table A5 is rounded to the nearest 100m.

The impact area due to 5G FWA above the lowest 800 MHz (i.e. 25.05 – 27.5 GHz)

A2.46 The impact area is shown in Figure A11 and the maximum impact distance is provided in Table A6

Figure A11: Impact area of outdoor 5G FWA above the lowest 800 MHz (i.e. 25.05-27.5 G GHz)

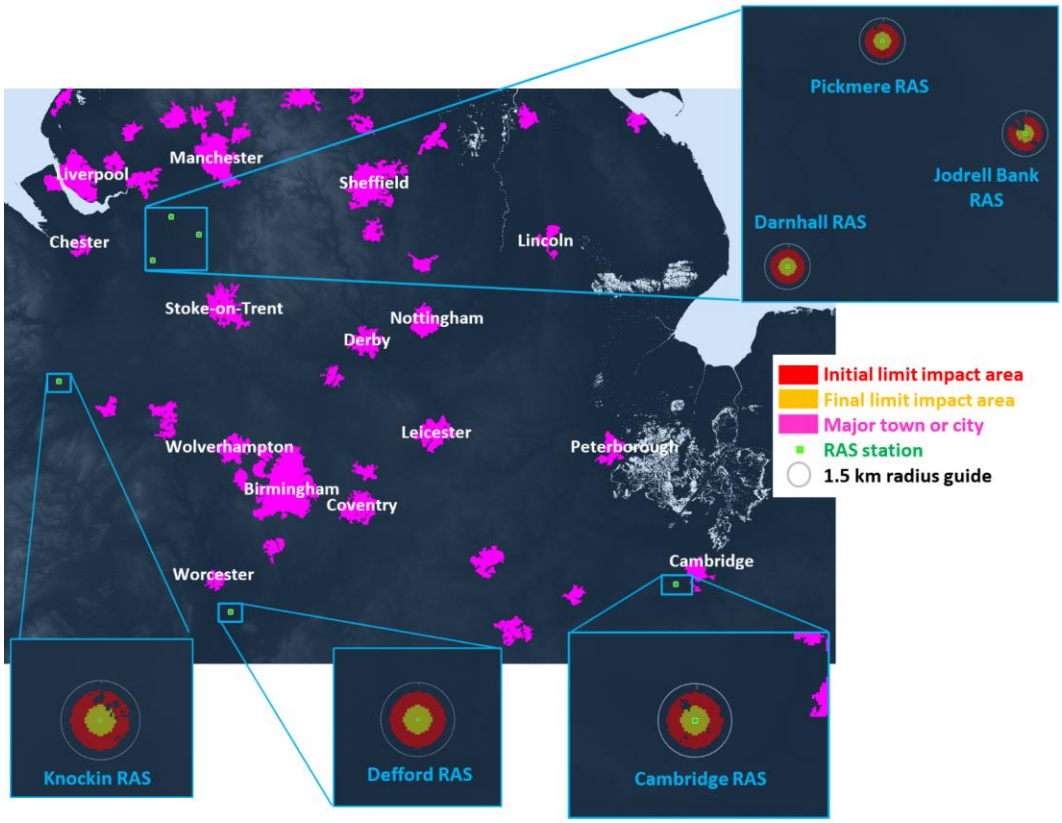


Table A6: The maximum impact distance for the outdoor 5G FWA above the lowest 800 MHz

Outdoor 5G base station OOB emission limit (dBW/200 MHz)	Maximum impact distance (m)
-33	1,100
-39	600

A2.47 The result in Table A6 is rounded to the nearest 100m.

Result of the impact area around RAS for indoor 5G base station

A2.48 Based on the modelling of the indoor scenario, the required propagation loss between the building and the radio astronomy station is around 99 dB when considering the initial OOB emission limit of -33 dBW/200 MHz, and around 93 dB for the final OOB emission limit of -39 dBW/200 MHz. At the 24 GHz frequency band, this equates to a propagation distance of less than 100m.

Summary of our analysis of the Impact Area around the RAS

A2.49 The impact area around each radio astronomy station is nearly a circular shape which indicates that it is not heavily influenced by geographical shielding. Since the 5G base station could point in any direction (including in the direction of the radio astronomy

station) and that the maximum impact distance is within a few hundred metres, we consider it appropriate to define this as an exclusion zone – circular in shape with the radius set to the maximum impact distance.

A2.50 As the radio astronomy stations including proposed exclusion zones of less than 5 km being largely located away from major towns and cities (as the grid references (given in table A1) for these sites indicate), we do not envisage that our proposed exclusion zones will significantly limit 5G deployment, although we note that there is uncertainty at this stage over where demand for 26 GHz spectrum will be.

Impact zones for single dish use

A2.51 In theory, two of the radio astronomy sites included in the e-MERLIN network (the ones located in Jodrell Bank and Cambridge) could also potentially be used for taking single dish measurements in the 24 GHz band. However, such single dish measurements are currently not being made and we are not aware of any plans to take single dish measurements in the future. Therefore, the analysis described above (paragraphs A2.8 – A2.50) has focused the impact on RAS measurements that are taken by the e-MERLIN network.

A2.52 The distances needed so that out-of-band emissions from outdoor 26 GHz deployments would not affect single dish measurements would extend to several tens of kilometres from these two sites and would reach areas of Manchester and Cambridge. For indoor-only 26 GHz deployments, the distances would be a few kilometres. See Figures A12 to A14.

A2.53 The consideration of single dish analysis uses the same methodology as defined earlier in this Annex paragraphs A2.11 – A2.16, but with a different RAS protection level. The protection level for single dish operation (i.e. -210 dBW/250 kHz) would be 42 dB more stringent than the e-MERLIN protection level and this would result in a significantly larger impact area. In some directions the larger impact is due to there being low propagation loss towards the radio astronomy station from some locations on distant high ground but local terrain around the radio astronomy stations could also shield some of the nearer 26 GHz base stations' OOB emissions and reduce the impact distance or create pockets of areas where any impact on the operation of the RAS would be unlikely, as shown in Figure A12.

Figure A12: Impact area of outdoor 5G FWA to RAS single dish in the lowest 800 MHz

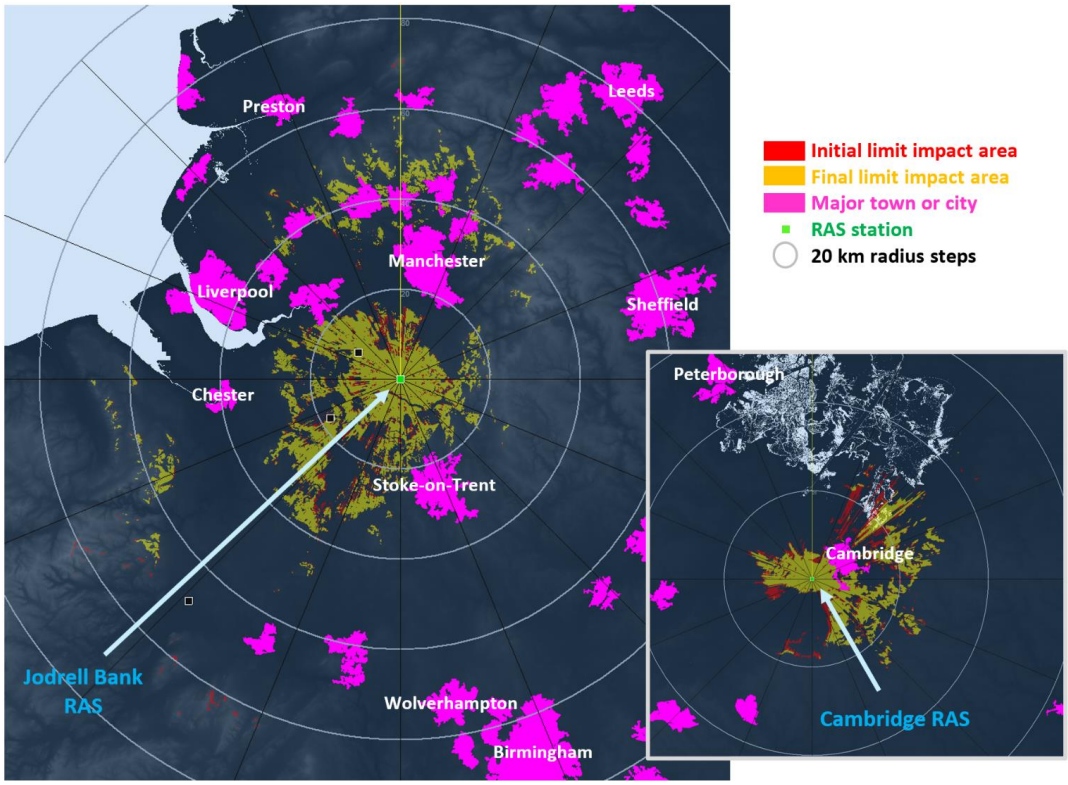
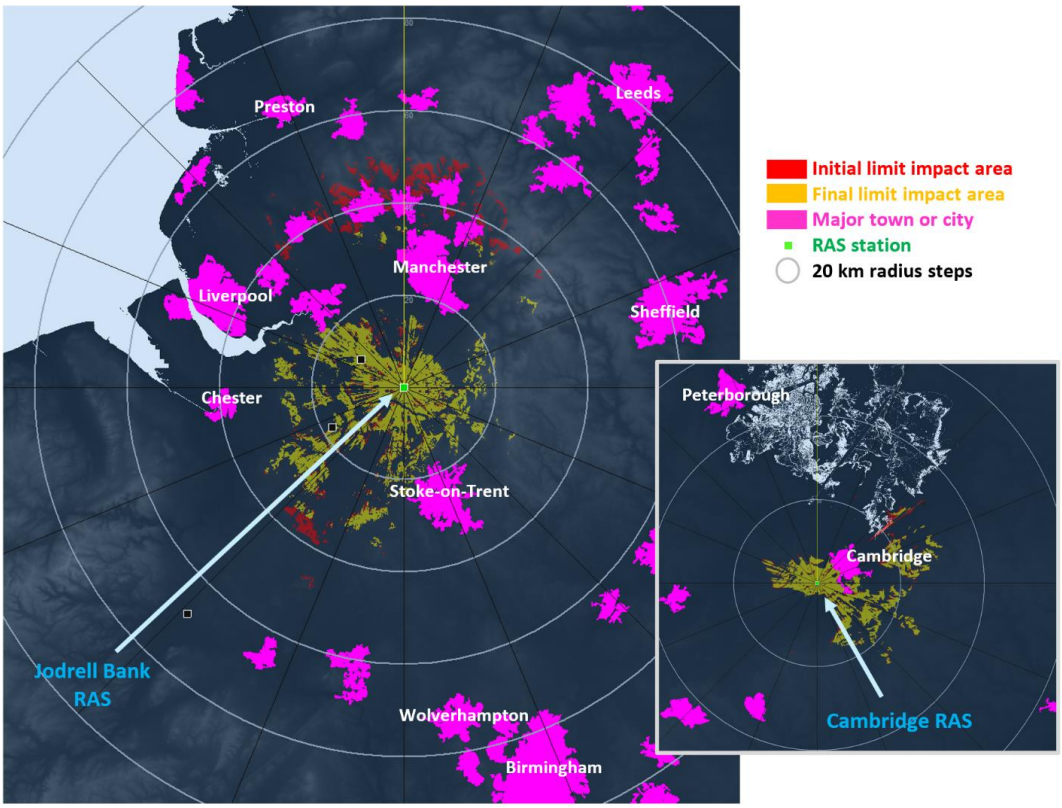
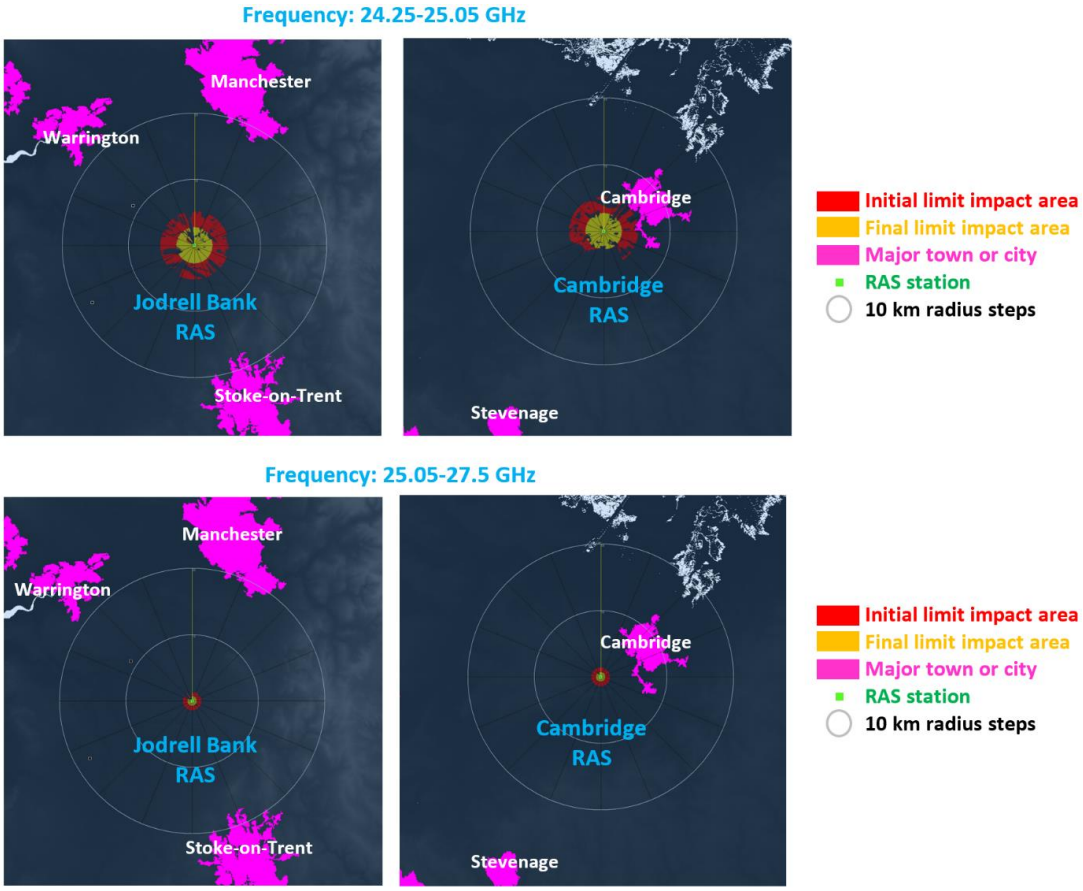


Figure A13: Impact area of outdoor 5G FWA to RAS single dish above the lowest 800 MHz



A2.54 The Impact area of indoor 5G to RAS single dish operation is illustrated in Figure A14.

Figure A14: Impact area of indoor 5G to RAS single dish



Coexistence analysis with EESS (passive) 23.6 – 24 GHz

A2.55 Below we explain how we have calculated our proposed limit on base station numbers to protect the EESS (passive) service.

A2.56 For the purposes of this consultation, we have considered whether any additional deployment conditions might be needed in addition to the harmonised technical conditions set out in the 26 GHz Decision (noting that less stringent limits will apply during the initial stage), and how to manage the mixed deployment of equipment using the initial limits with equipment using the final limits. We took the following steps to derive a formula for the combined number of base stations using the initial and final OOB emission limits that could be deployed in a 300 km^2 area without breaching the sensor protection criteria:

- We started with the latest available satellite sensor protection requirements (we have used the parameters in Recommendation ITU-R RS.1861[49] for the F8 sensor,

[49] Recommendation ITU-R RS.1861-0: Typical technical and operational characteristics of Earth exploration-satellite service (passive) systems using allocations between 1.4 and 275 GHz.

which is currently the most sensitive sensor[50] and the performance and interference criteria are taken from Recommendation ITU-R RS.2017[51]).

- We converted the number of base stations that was used in the studies for WRC-19 from the 306 km^2 F8 sensor field of view to a round number of 300 km^2.
- We then determined the contribution from multiple 200 MHz channels to the OOB emissions seen by the EESS sensor, taking account of how much the emissions drop with every 200 MHz increase in frequency separation.
- We then calculated the aggregate interference threshold (the sum of emissions from all base stations) in this 300km^2 area for a single 200 MHz channel, taking account of manufacturing margin
- We then calculated the equivalent aggregate interference threshold for other channel sizes from 50 MHz to 800 MHz.

A2.57 As set out above, the 5G characteristics and parameters (including deployment density) that we have modelled are taken from the 5G parameters document[45] used for the WRC-19 studies.

A2.58 These EESS (passive) satellites scan the surface of the earth at an elevation angle of at least 25°, and it is reasonable to assume that the interference from 5G indoor base stations towards these satellites will be negligible due to the signal loss from penetrating through the roof and ceiling of the building and in comparison with outdoor base stations. Therefore, we do not consider it is necessary to study the effect of indoor 5G systems towards the EESS (passive) satellites and assume that it does not contribute to the aggregate interference from outdoor 5G systems to these satellites.

A2.59 WRC-19 agreed an out-of-band emission limit of −39dBW/200 MHz, based on the parameters of the F3 sensor and agreement that there should be no high-density mobile deployment in the frequency band immediately below 23.6 GHz. Our calculations take into account that the protection requirements of the F8 sensor are 2 dB less stringent than F3, so we have used an aggregate value of emissions which is equivalent to a deployment of base stations (the quantity that was in the sensor's instantaneous field of view in the ITU studies) emitting OOB levels of −37dBW/200 MHz per base station.

A2.60 As the F8 sensor is now the most sensitive sensor that will be used in the band, protecting this F8 sensor means that all other sensors operating in the band will also be protected.

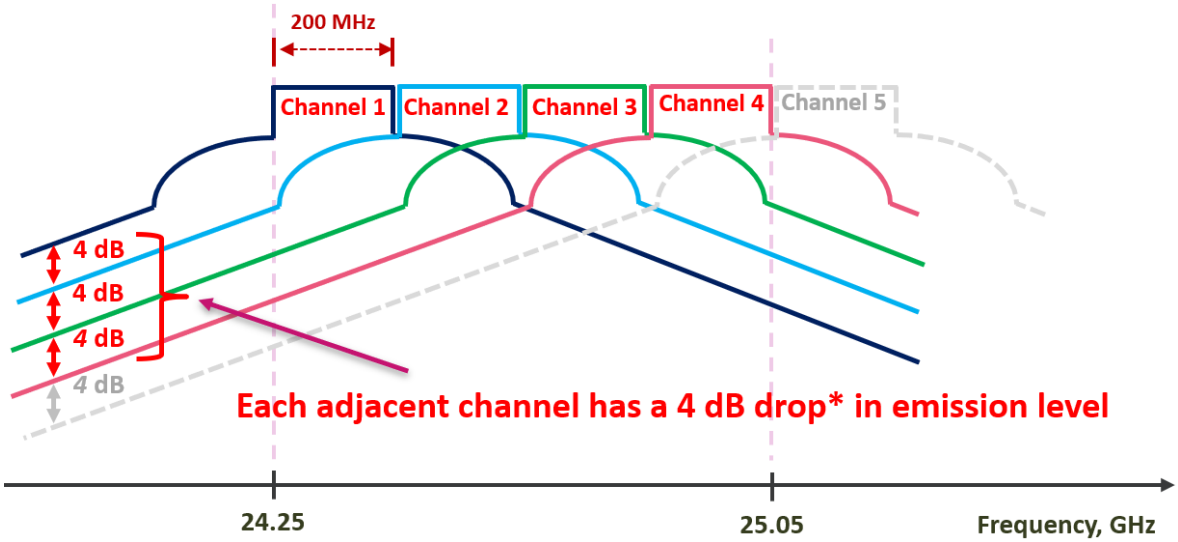
5G OOB emission assumption for the EESS (passive) analysis

A2.61 The studies from CEPT administrations (Study A and Study J in document R15/TG5.1/478N03-P2) leading to WRC-19 have modelled this OOB emission characteristic and considered that whilst the bottom channel dominates the OOB emission below 24.0 GHz, it is necessary to include up to 2 dB in the modelling to account for additional OOB emission contribution from the other channels in the 26 GHz band.

[50] This is because the F3 sensor – which was used in the WRC-19 studies – is no longer going to be deployed.
[51] Recommendation ITU-R RS.2017-0: Performance and interference criteria for satellite passive remote sensing.

A2.62 The protection of the 24 GHz EESS (passive) service is derived from the most sensitive passive sensor that will be in operation in this frequency band which covers an area of 300 km^2. Since the interference analysis for the EESS (passive) is considering an aggregation of hundreds of base stations with varying network loading (which means that within the satellite IFOV, the OOB emissions from the base stations will be less than if every base station was at 100% loading), we have based our analysis on a "typical" base station with a 4 dB reduction in OOB emission level per 200 MHz frequency separation. The slope is illustrated in Figure A12.

Figure A12: 5G OOB emission assumption for the EESS (passive) analysis



A2.63 This leads to the case where Channels 2 to 4 (i.e. 24.45 – 25.05 GHz) adds a further 2 dB in interference to the interference level from the first channel (i.e. 24.25 – 24.45 GHz). This 2 dB increase in emissions is consistent with the assumptions in the CEPT studies leading up to WRC-19. Subsequent channels from 25.05 GHz onwards would therefore make a negligible contribution to the overall interference level received below 24.00 GHz. Therefore, we do not consider that it is necessary to constrain 5G deployments that operate above the lowest 800 MHz of the 26 GHz frequency band (i.e. above 25.05 GHz).

A2.64 It is common for vendors to manufacture their base station with a certain margin in order to ensure they meet the regulatory limit. Based on the information that GSA has provided to the ECC in document ECC(18)035 and potential uncertainties on product design margins, we are assuming this implementation margin to be 2 dB (on average). Hence, all elements of the OOB emission level are reduced by 2 dB.

Calculating the maximum aggregate interference from outdoor 5G base stations before breaching the aggregate interference threshold

A2.65 In our analysis, we are protecting the most sensitive F8 sensor. Based on the studies from CEPT Administrations, the typical number of base stations (derived from the sharing and

compatibility parameters[40]) within the 306 km^2 footprint (instantaneous field of view, IFOV) of the F8 is 452. Rounding the footprint to 300 km^2 means it will contain 443 base stations.

A2.66 The base stations we have assumed in our analysis have a single sector with a horizontal coverage angle of about 120° serving terminal stations within their boresight.

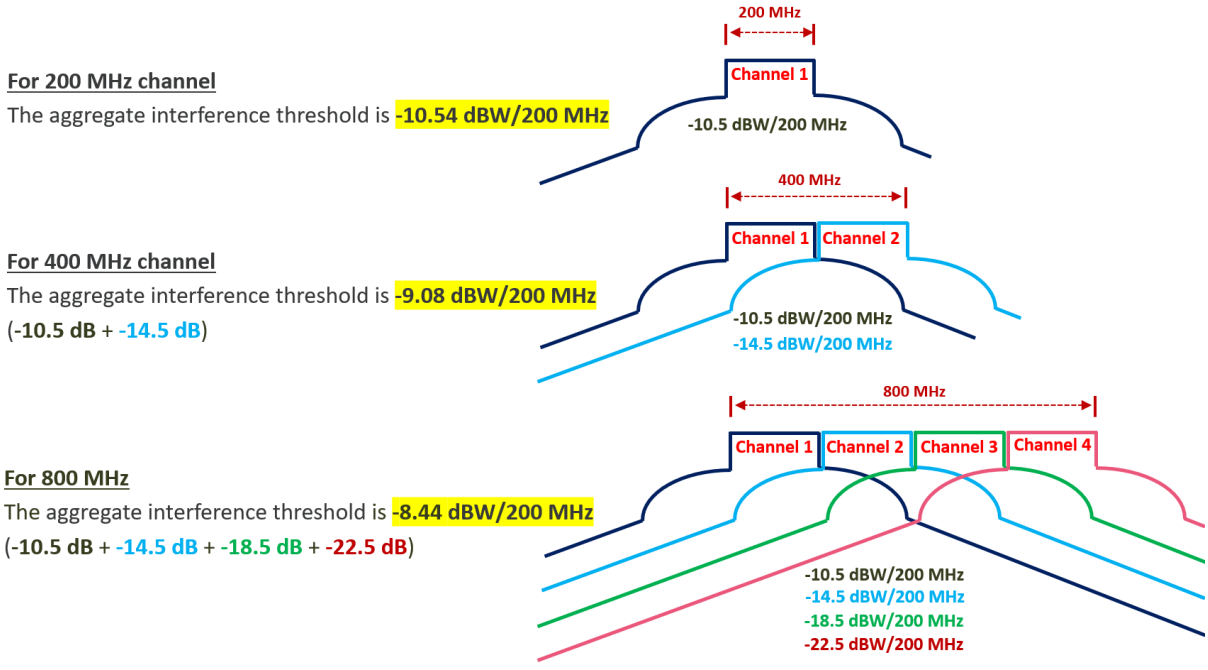
A2.67 Given that the OOB emission level for every base station to ensure the protection of the F8 sensor is -37 dBW/200 MHz, the aggregate interference threshold for a single 200 MHz channel in a 300 km^2 area for the 443 base stations is -10.54 dBW/200 MHz.

A2.68 Based on the assumption of 4 dB drop for every 200 MHz frequency separation, the aggregation effect for the first four 200 MHz channels will revise this interference level to −8.44 dBW/200 MHz.

Calculating the aggregate interference threshold for different channel sizes

A2.69 The aggregate interference threshold for different channel sizes can be calculated based on the 5G OOB emission characteristics indicated earlier. An illustration of the aggregate interference threshold for channel size 200 MHz, 400 MHz and 800 MHz is shown in Figure A13. The current ETSI 5G technical specification[52] is indicating channel bandwidths of up to 400 MHz, but an 800 MHz channel shown here is for completeness.

Figure A13: The aggregate interference threshold for channel sizes 200 MHz, 400 MHz and 800 MHz



A2.70 For channel sizes of less than 200 MHz, the concept is the same where it relates to the same aggregate interference threshold of the 200 MHz channel size. Based on the 5G OOB

[52] ETSI TS 138 104 v16.9.0 (2021-10) Technical specification – 5G; NR; Base Station (BS) radio transmission and reception (3GPP TS 38.104 version 16.9.0 Release 16).

emission characteristic indicated earlier, the OOB emission level drops 4 dB every 200 MHz, or 1 dB for every 50 MHz, or 2 dB for every 100 MHz. Therefore, the aggregate interference threshold for channel size 200 MHz, 100 MHz and 50 MHz is illustrated in Figure A14.

Figure A14: The aggregate interference threshold for channel sizes 200 MHz, 100 MHz and 50 MHz

For 200 MHz channel

The aggregate interference threshold for each 200 MHz channel is:

- **-10.54 dBW/200 MHz** for **Channel A**

For 100 MHz channel

The aggregate interference threshold for each 100 MHz channel is:

- **-12.66 dBW/200 MHz** for **Channel 1**

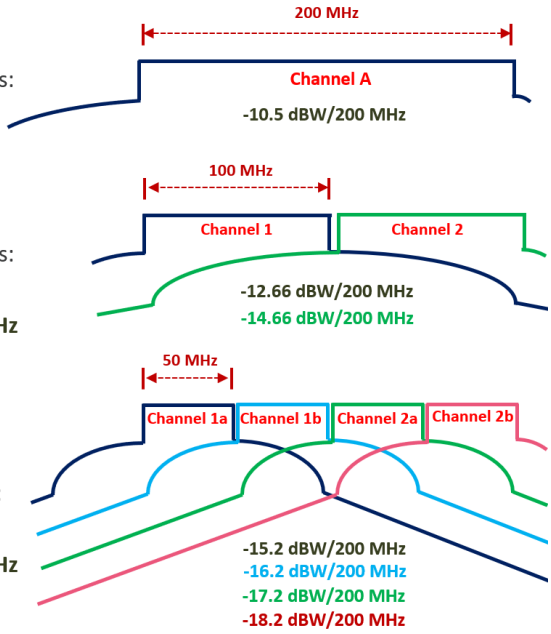
200 MHz aggregate interference threshold is **-10.54 dBW/200 MHz** (-12.66 dB + -14.66 dB)

For 50 MHz channel

The aggregate interference threshold for each 50 MHz channel is:

- **-15.20 dBW/200 MHz** for **Channel 1a**

200 MHz aggregate interference threshold is **-10.54 dBW/200 MHz** (-15.2 dB + -16.2 dB + -17.2 dB + -18.2 dB)



A2.71 It is important to note that this aggregate interference threshold for the same channel size is the same regardless of where it is in the lowest 800 MHz (i.e. 24.25-25.05 GHz), and the maximum number of base stations would also need to be subject to some restriction if part of the channel falls inside this band. For example, if a block uses a 400 MHz channel at the frequency 24.85-25.25 GHz (part of it is outside the lowest 800 MHz spectrum), the entire channel is subject to the same aggregate interference threshold of the 200 MHz channel (not 400 MHz).

A2.72 A summary of the aggregate interference threshold is shown in Table A8.

Table A8: Summary of the aggregate interference threshold for different channel size

Channel Size (MHz)	Aggregate Interference threshold (dBW/200 MHz)
50	-15.20
100	-12.66
200	-10.54
400	-9.08
800	-8.44

Final step: Calculating the maximum number of base stations within a 300 km^2 area from the aggregate interference threshold

A2.73 As indicated in A2.64 we are assuming a vendor implementation margin of 2 dB for compliance with regulatory OOB emission limits. Incorporating this margin means that when a vendor is required to meet a limit of -33 dBW/200 MHz, we assume on average the emission level to be -35 dBW/200 MHz. Similarly, for a vendor to meet the limit of -39 dBW/200 MHz, we assume on average an emission level of -41 dBW/200 MHz.

A2.74 The number of base stations that can be deployed within 300 km^2 at a particular channel size can be calculated based on how many are deployed at the -33 dBW/200 MHz OOB emission regulatory limit or how many are deployed at the -39 dBW/200 MHz OOB emission regulatory limit.

A2.75 We have taken an equal interference distribution approach when calculating the aggregate interference threshold afforded to the different channel size regardless of where the channel is within 24.25-25.05 GHz. However, we note that it would also be possible to skew this interference distribution to different parts of the 24.25-25.05 GHz frequency band.

A2.76 The number of BS that can be deployed is based on Equation below:

Equation 1

$$(\mathrm{P}_{Initial} \times NBS_{Initial}) + (\mathrm{P}_{Final} \times NBS_{Final}) \leq \text{Aggregate interference threshold (linear)}$$

where

$\mathrm{P}_{Initial}$:	average base station OOB emission level at Initial OOB emission Limit:	$10^{-35/10}$ (W/200 MHz)
P_{Final}:	average base station OOB emission level at Final OOB emission Limit:	$10^{-41/10}$ (W/200 MHz)
$NBS_{Initial}$:	number of base stations at Initial OOB emission Limit	
NBS_{Final}:	number of base stations at Final OOB emission Limit	

A2.77 Although the calculations in the analysis are based on the baseline hotspot deployment, the maximum number of base stations includes FWA base station deployment as well. The elevation angle to the EESS (passive) sensors ranges between 25° to 90°, and the overall emissions at these elevation angles are similar despite FWA base station having higher peak power generally pointing below the horizon. The interference towards the EESS (passive) satellites are from the base station's antenna array side lobes at much lower power levels.

Example 1

A2.78 For a channel size of 200 MHz and a deployment of 50 base stations that are under the initial limit of -33 dBW/200 MHz, the number of base stations that can be deployed with the final limit of -39 dBW/200 MHz is calculated as follows:

$$(\mathrm{P}_{Initial} \times NBS_{Initial}) + (\mathrm{P}_{Final} \times NBS_{Final}) \leq \text{Aggregate interference threshold (linear)}$$

$$\left(10^{-35/10} \times 50\right) + \left(10^{-41/10} \times NBS_{Final}\right) \leq 10^{-10.54/10}$$

$$NBS_{Final} \leq 912.6$$

Therefore, you could deploy up to 912 base stations at the final limit.

Example 2

A2.79 For a channel size of 400 MHz and a deployment of 30 base stations under the initial limit of -33 dBW/200 MHz, the number of base stations that can be deployed at the final limit of -39 dBW/200 MHz is calculated as follows:

$$(\mathrm{P}_{Initial} \times NBS_{Initial}) + (\mathrm{P}_{Final} \times NBS_{Final}) \leq \text{Aggregate interference threshold (linear)}$$

$$\left(10^{-35/10} \times 30\right) + \left(10^{-41/10} \times NBS_{Final}\right) \leq 10^{-9.08/10}$$

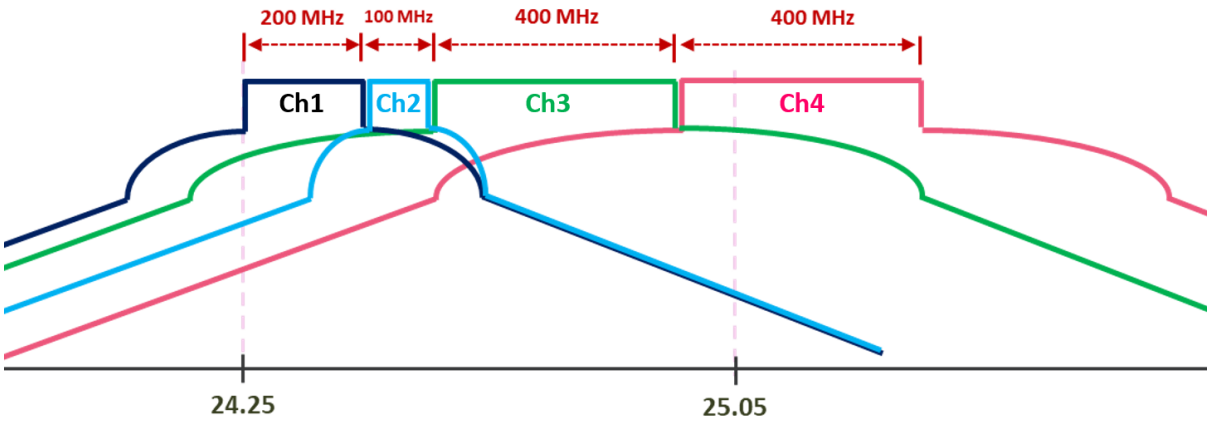
$$NBS_{Final} \leq 1436.5$$

Therefore, you could deploy up to 1436 base stations at the final limit.

Example 3

A2.80 This example shows the situation where we have 4 channel blocks occupying different parts of the spectrum with different channel sizes as shown in Figure A15.

Figure A15: Example of occupancy with different channel sizes



A2.81 Table A9 illustrates the number of base stations that each block of channel could deploy within their given aggregate interference threshold. This is based on the formula indicated in the previous example.

$$(\mathrm{P}_{Initial} \times NBS_{Initial}) + (\mathrm{P}_{Final} \times NBS_{Final}) \leq \text{Aggregate interference threshold (linear)}$$

Table A9: An example of the number of base stations for the different channel sizes at different OOB limits.

Channel	Aggregate Interference Threshold (dBW/200 MHz)	Number of Base Stations	
		-33 (dBW/200 MHz)	-39 (dBW/200 MHz)
Ch1	-10.54	45	932
Ch2	-12.66	25	582
Ch3	-9.08	15	1496
Ch4	-12.66*	30	562

*Only 100 MHz of the 400 MHz channel is inside the lowest 800 MHz of the 26 GHz band where restrictions on the number of base stations would apply

A2.82 For a given number of base stations at the initial limit (i.e. 45, 25, 15 and 30), the number of base stations that they could deploy at the final limit can be calculated by rearranging Equation , as shown in Equation 2:

Equation 2

$$NBS_{Final} \leq \frac{\left(\text{Aggregate interference threshold (linear)} - (\mathrm{P}_{Initial} \times NBS_{Initial})\right)}{\mathrm{P}_{Final}}$$

A2.83 It is also possible to conceive examples where there will be 50 MHz, 100 MHz and 200 MHz channels in use within a particular 200 MHz frequency range at different locations within the satellite IFOV. We have not provided an example for this scenario.

Base stations interference contribution for the lowest 800 MHz (i.e. 24.25 – 25.05 GHz)

A2.84 The approach set out above can if necessary, also accommodate different base station deployment scenarios including mixed overlapping channel sizes with different OOB emission limits. For example, the number of base stations that can be deployed in the lowest 800 MHz spectrum within any 300 km^2 area can be restricted by the maximum aggregate interference (within the EESS (passive) frequency band) of -8.44 dBW/200 MHz.

A2.85 The interference contribution of an individual base station depends on the average OOB emission level described earlier and its operating frequency within the lowest 800 MHz spectrum (i.e. 24.25 – 25.05 GHz). For example, for a base station with a channel size of 100 MHz operating at the initial OOB limit of -33 dBW/200 MHz and operating at 24.40 – 24.50 GHz, its interference contribution at the EESS (passive) band of 23.6 – 24 GHz frequency band is -38 dBW/200 MHz. This accounts for an OOB level drop of 3 dB for operating 150 MHz from the lower edge of 24.25 GHz, and at an average base station OOB emission level of -35 dBW/200 MHz as described in A2.73.

A2.86 The total interference contribution from all individual base station operating in the lowest 800 MHz spectrum within any 300 km^2 area must be lower than -8.44 dBW/200 MHz.

Question 4

Do you agree with the technical analysis set out in Annex 2? If not, please explain your reasons for this providing detailed supporting evidence.

A3. Responding to this consultation

How to respond

A3.1 Ofcom would like to receive views and comments on the issues raised in this document, by 5pm on 24 February 2022.

A3.2 You can download a response form from the Ofcom website. You can return this by email or post to the address provided in the response form.

A3.3 If your response is a large file, or has supporting charts, tables or other data, please email it to ProtectingSpaceScience24GHz@ofcom.org.uk, as an attachment in Microsoft Word format, together with the cover sheet. This email address is for this consultation only, and will not be valid after we issue the Statement in the second half of 2022.

A3.4 Responses may alternatively be posted to the address below, marked with the title of the consultation:

26 GHz OOB project team
Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA

A3.5 We welcome responses in formats other than print, for example an audio recording or a British Sign Language video. To respond in BSL:

a) Send us a recording of you signing your response. This should be no longer than 5 minutes. Suitable file formats are DVDs, wmv or QuickTime files. Or

b) Upload a video of you signing your response directly to YouTube (or another hosting site) and send us the link.

A3.6 We will publish a transcript of any audio or video responses we receive (unless your response is confidential)

A3.7 We do not need a paper copy of your response as well as an electronic version. We will acknowledge receipt if your response is submitted via the online web form, but not otherwise.

A3.8 You do not have to answer all the questions in the consultation if you do not have a view; a short response on just one point is fine. We also welcome joint responses.

A3.9 It would be helpful if your response could include direct answers to the questions asked in the consultation document. The questions are listed at Annex A4. It would also help if you could explain why you hold your views, and what you think the effect of Ofcom's proposals would be.

A3.10 If you want to discuss the issues and questions raised in this consultation, please contact the project team at ProtectingSpaceScience24GHz@ofcom.org.uk.

Confidentiality

A3.11 Consultations are more effective if we publish the responses before the consultation period closes. In particular, this can help people and organisations with limited resources or familiarity with the issues to respond in a more informed way. So, in the interests of transparency and good regulatory practice, and because we believe it is important that everyone who is interested in an issue can see other respondents' views, we usually publish all responses on the Ofcom website as soon as we receive them.

A3.12 If you think your response should be kept confidential, please specify which part(s) this applies to and explain why. Please send any confidential sections as a separate annex. If you want your name, address, other contact details or job title to remain confidential, please provide them only in the cover sheet, so that we don't have to edit your response.

A3.13 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and try to respect it. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.

A3.14 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's intellectual property rights are explained further in our Terms of Use.

Next steps

A3.15 Following this consultation period, Ofcom plans to publish a statement in summer 2022.

A3.16 If you wish, you can register to receive mail updates alerting you to new Ofcom publications.

Ofcom's consultation processes

A3.17 Ofcom aims to make responding to a consultation as easy as possible. For more information, please see our consultation principles in Annex A2.

A3.18 If you have any comments or suggestions on how we manage our consultations, please email us at consult@ofcom.org.uk. We particularly welcome ideas on how Ofcom could more effectively seek the views of groups or individuals, such as small businesses and residential consumers, who are less likely to give their opinions through a formal consultation.

A3.19 If you would like to discuss these issues, or Ofcom's consultation processes more generally, please contact the corporation secretary:

Corporation Secretary
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA
Email: corporationsecretary@ofcom.org.uk

A4. Ofcom's consultation principles

Ofcom has seven principles that it follows for every public written consultation:

Before the consultation

A4.1 Wherever possible, we will hold informal talks with people and organisations before announcing a big consultation, to find out whether we are thinking along the right lines. If we do not have enough time to do this, we will hold an open meeting to explain our proposals, shortly after announcing the consultation.

During the consultation

A4.2 We will be clear about whom we are consulting, why, on what questions and for how long.

A4.3 We will make the consultation document as short and simple as possible, with a summary of no more than two pages. We will try to make it as easy as possible for people to give us a written response. If the consultation is complicated, we may provide a short Plain English / Cymraeg Clir guide, to help smaller organisations or individuals who would not otherwise be able to spare the time to share their views.

A4.4 We will consult for up to ten weeks, depending on the potential impact of our proposals.

A4.5 A person within Ofcom will be in charge of making sure we follow our own guidelines and aim to reach the largest possible number of people and organisations who may be interested in the outcome of our decisions. Ofcom's Consultation Champion is the main person to contact if you have views on the way we run our consultations.

A4.6 If we are not able to follow any of these seven principles, we will explain why.

After the consultation

A4.7 We think it is important that everyone who is interested in an issue can see other people's views, so we usually publish all the responses on our website as soon as we receive them. After the consultation we will make our decisions and publish a statement explaining what we are going to do, and why, showing how respondents' views helped to shape these decisions.

A5. Consultation coversheet

BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

Please tick below what part of your response you consider is confidential, giving your reasons why

Nothing ☐

Name/contact details/job title ☐

Whole response ☐

Organisation ☐

Part of the response ☐

If there is no separate annex, which parts? _____

_____

If you want part of your response, your name or your organisation not to be published, can Ofcom still publish a reference to the contents of your response (including, for any confidential parts, a general summary that does not disclose the specific information or enable you to be identified)?

DECLARATION

I confirm that the correspondence supplied with this cover sheet is a formal consultation response that Ofcom can publish. However, in supplying this response, I understand that Ofcom may need to publish all responses, including those which are marked as confidential, in order to meet legal obligations. If I have sent my response by email, Ofcom can disregard any standard e-mail text about not disclosing email contents and attachments.

Ofcom seeks to publish responses on receipt. If your response is non-confidential (in whole or in part), and you would prefer us to publish your response only once the consultation has ended, please tick here.

Name Signed (if hard copy)

A6. Consultation questions

Question 1

For future outdoor use of 26 GHz, do you agree that the proposed exclusion zones will provide appropriate protection to the 6 radio astronomy sites? If not please explain your reasons for this providing any supporting evidence.

Question 2

For indoor use of 26 GHz, do you agree that additional measures are not needed to protect radio astronomy sites and that we should remove the existing 1 km exclusion zone around Jodrell Bank and Cambridge from the current 26 GHz indoor-only shared access licence product? If not, please explain your reasons for this providing any supporting evidence.

Question 3

Do you agree with our proposal to limit the number of 26 GHz base stations in 24.25-25.05 GHz to protect EESS (passive) use at 24 GHz? If not, please explain your reasons for this providing detailed supporting evidence.

Question 4

Do you agree with the technical analysis set out in Annex 2? If not, please explain your reasons for this providing detailed supporting evidence.