
Ofcom's proposals to update the technical conditions of mobile licences in the 800 MHz band

CONSULTATION:

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1. Overview

Spectrum enables wireless services, including mobile phones and WiFi, to be used by people and businesses every day. Ofcom has the job of ensuring this vital resource is used in the best interests of everyone in the UK.

Ofcom manages the spectrum either by issuing licences or by making regulations that mean that certain devices do not require one. These authorisations contain technical parameters that users of the equipment must adhere to. They include amongst other things technical conditions, such as the frequency, location and the maximum transmit power that can be used. We aim, where possible, to impose the least restrictive conditions on users. However sometimes, over time as technology develops or the use of the spectrum changes, the conditions that we imposed may no longer be appropriate. In these cases, we review the conditions to see whether they should be updated.

What we are consulting on - in brief

Now that we have awarded the adjacent 700MHz band for mobile use, we think there are changes we could make to our Spectrum Access 800 MHz licences which would enable mobile network operators to improve their network coverage and increase capacity. We are therefore proposing to:

Align the in-block transmit power limit with the recently awarded 700 MHz band. Our proposal is to increase the permitted base station transmit power from 61 dBm/(5 MHz) EIRP to 64 dBm/(5 MHz) EIRP. We are also proposing to change the way in which the power limit is referenced moving from per radio equipment to per antenna. As part of this change femtocells must implement power controls to minimise interference to adjacent channels. The use of these higher powers would be subject to the operator having in place a mitigation scheme to protect Digital Terrestrial Television (DTT) viewers should interference arise;

To help facilitate equipment manufacturers make equipment that is capable to use both the 700 MHz and 800 MHz bands we are proposing to amend some out-of-band and out-of-block limits. This is to closer align the limits with the conditions set out in the Spectrum Access 700 MHz licences and with the European Conference of Postal and Telecommunications Administrations (CEPT) mask for the 800 MHz band.

- 1.1 Ofcom has received requests from two network operators, Hutchison 3G and BT/EE, asking that we vary their Spectrum Access 800 MHz licences to increase the permitted in-block transmit power from 61 dBm/(5 MHz) EIRP to 64 dBm/(5 MHz) EIRP. They requested the variation in order to increase their network capacity, facilitate the rollout of new antenna designs, and improve geographic and in-building coverage capabilities of their networks.
- 1.2 The request prompted us to undertake a wider review of the technical conditions in the Spectrum Access 800 MHz licences as we believed that this was an appropriate time to do so. Our review took into account the advances in technology since the licences were awarded in 2013 and the change of use of the adjacent 700 MHz band from Digital Terrestrial Television (DTT) to another mobile service.

- 1.3 Our provisional decision is that we are minded to agree to the power increase, subject to the operators having in place a mitigation scheme to protect DTT viewers, but we are also proposing to go further and propose other changes to the licences. We want to further align power limits with the Spectrum Access 700 MHz licences by applying the in-block limits per antenna and relaxing the out-of-band emission limits between 733 and 790 MHz. We also propose to set the out-of-block limits between 791 to 821 MHz and the out-of-band transitional limits in 790 to 791 MHz and 821 to 832 MHz to align with the limits set out in the European Conference of Postal and Telecommunications Administrations (CEPT) Report 30.¹
- 1.4 It has been highlighted to us, that the current out-of-band emission mask below 790 MHz can make it difficult to build base station equipment which transmits in both the 700 MHz and 800 MHz bands. There is a desire from equipment suppliers to build a single base station that can be used for the 700 MHz and 800 MHz band together due to the proximity of the downlink frequency bands. Our proposed changes should make it easier for manufacturers to build equipment that will facilitate operators in rolling out in both bands.
- 1.5 Due to a small risk of interference to DTT equipment, we are proposing that a requirement of the proposed power increase would be that any operator, that wishes to take advantage of this, must set up a scheme to help and assist DTT viewers to resolve any interference should it occur. Licensees will have to provide Ofcom details of their proposed scheme which we will need to review before they can begin transmitting above the current 61 dBm/(5 MHz) EIRP per radio equipment in-block power limit as set out in their licence. Licensees that do not wish to transmit above their current in-block power parameters will not be required to put in place this mitigation scheme.
- 1.6 Licensees are required to show compliance with the internationally recognised guidelines on electromagnetic fields (EMF) for the protection of the general public. These guidelines are set by the International Commission for Non-Ionising Radiation Protection (ICNIRP) and ensure that these sites are operated in a way that does not adversely affect people's health. We expect that, even if these operators use the increased power, the emission limits will remain well within the guidelines that we have set.
- 1.7 These proposed changes would be available to all Spectrum Access 800 MHz licensees. Affected licensees and any other interested parties will have until 5pm on 7 September 2021 to respond to this consultation. If we decide to proceed, we will begin the process to vary Spectrum Access 800 MHz licences shortly after issuing our statement.
- 1.8 The overview section in this document is a simplified high-level summary only. The proposals we are consulting on and our reasoning are set out in the full document.

¹ CEPT Report 30 "The identification of common and minimal (least restrictive) technical conditions for 790 - 862 MHz for the digital dividend in the European Union", published 30 October 2009 <https://docdb.cept.org/download/41>

2. Background

Spectrum Access 800 MHz licences

- 2.1 BT/EE, Hutchison 3G (H3G), Telefonica (O2) and Vodafone all hold Spectrum Access 800 MHz licences in 790 to 862 MHz (the “800 MHz band”). The licences were awarded by auction in 2013.
- 2.2 The majority of the technical conditions for the licences were set out in the European Commission Decision of 6 May 2010, on harmonised technical conditions of use of the 790 to 862 MHz band for terrestrial systems capable of providing electronic communications services in the European Union (2010/267/EC) (the “800 MHz Decision”).² This detailed the technical parameters that European Union (EU) Member States have to apply when designating the use of the 800 MHz band for networks (other than high-power broadcasting networks).
- 2.3 In certain cases the 800 MHz Decision provided a range of technical limits that Member States should consider, depending on their national circumstances. In other cases, no limits were prescribed. This was the case for the in-band power limit where the decision did not require one to be set. It did suggest that if one were to be applied that it would normally be in the range 56 to 64 dBm / (5 MHz) EIRP unless otherwise justified.
- 2.4 In 2011 we consulted³ on the technical licence conditions for using the 800 MHz band that we were proposing to implement in the upcoming award. As well as the proposed in-block power limits the document also included the options regarding the out-of-band limits we would apply to protect the adjacent Digital Terrestrial Television (DTT) services. We published our decision relating to these in 2012.⁴
- 2.5 Another condition placed on licensees as part of the award was that they needed to ensure that viewers of DTT would not be impacted by the deployment of mobile services in the 800 MHz band. This implemented Government decisions in relation to DTT coexistence.⁵ Licensees were required to put in place a scheme to help ensure that, if interference suffered by DTT viewers was caused by the deployment of a mobile base station, they needed to resolve it or, if it could not be, a suitable alternative way of accessing TV services was offered. The four licensees funded at800⁶ which was set up to deal with any problems should they arise.

² 800 MHz Decision <http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:117:0095:0101:EN:PDF>

³ Consultation and information on technical licence conditions for 800 MHz and 2.6 GHz spectrum and related matters https://www.ofcom.org.uk/data/assets/pdf_file/0009/30024/condoc.pdf published 2 June 2011

⁴ Assessment of future mobile competition and award of 800 MHz and 2.6 GHz https://www.ofcom.org.uk/data/assets/pdf_file/0031/46489/statement.pdf published 24 July 2012

⁵ <https://webarchive.nationalarchives.gov.uk/20121204121842/http://www.culture.gov.uk/images/publications/letter-dcms-ofcom-10072012.pdf>

⁶ <https://at800.tv/about/>

Spectrum Access 700 MHz licences

- 2.6 The 700 MHz and 3.68 to 3.8 GHz frequency bands were awarded by auction which completed on 27 April 2021. The winners of 700 MHz spectrum were BT/EE, H3G and O2. The only holder of 800 MHz spectrum to not obtain a 700 MHz licence was Vodafone.
- 2.7 Although the United Kingdom is no longer a member state of the EU, EU law continued to apply in the UK for a transitional period. This transitional period ended on 31 December 2020. The European Commission Implementing Decision (EU) 2016/6872 of 28 April 2016 harmonised the technical conditions for the availability and efficient use of the 694 to 790 MHz frequency band for terrestrial systems capable of providing wireless broadband electronic communications services (the “700 MHz Decision”).⁷ Like the 800 MHz Decision, the 700 MHz Decision included harmonised technical provisions that Member States had to implement into their licences.
- 2.8 On 17 May 2017, the European Parliament and Council adopted Decision 2017/8993,⁸ which required Member States to repurpose the 700 MHz frequency band from TV broadcasting and PMSE use to new mobile broadband use by 30 June 2020. In doing so, EU Member States had to apply the technical conditions laid down in the 700 MHz Decision.
- 2.9 The 700 MHz Decision provided a range of technical limits that EU Member States should adopt depending on what services were in the band including mobile, Machine-to-machine (M2M) or public protection and disaster relief (PPDR). A key requirement was that Member States must adopt the paired band plan and block edge masks for the use of 703 to 733 MHz paired with 758 to 788 MHz. The decision also includes several options for the 733 to 758 MHz “centre gap”, including a band plan and block edge mask for 20 MHz of downlink-only use. No mandatory in-block power limit was set in the 700 MHz Decision but it suggested that where an upper limit is desired by an administration it should not exceed 64 dBm/(5 MHz) per antenna.
- 2.10 We consulted on the technical limits in 2019. The 700 MHz Decision provides several measurement bandwidth options for assessing out-of-block emissions limits of the 700 MHz uplink and downlink. As we planned to award the 700 MHz band in lots of 5 MHz we proposed 5 MHz as a unit of measurement. We also proposed that we would not be imposing the more stringent out-of-band limits for 733 to 736 MHz or 788 to 791 MHz as we had at that time no firm plans for PPDR or M2M to use those particular frequencies. We confirmed these limits in our statement published in 2020.⁹
- 2.11 Similar to Spectrum Access 800 MHz licences, holders of the Spectrum Access 700 MHz licences were required collectively to set up and operate a scheme to provide advice and assistance to DTT viewers suffering undue interference from mobile services and resolve it. However unlike the 800 MHz award, the Spectrum Access 700 MHz licences did not prescribe

⁷ 700 MHz Decision <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016D0687&from=EN>

⁸ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017D0899&from=en>

⁹ Award of the 700 MHz and 3.6-3.8 GHz spectrum bands statement

https://www.ofcom.org.uk/data/assets/pdf_file/0020/192413/statement-award-700mhz-3.6-3.8ghz-spectrum.pdf
published 13 March 2020

in detail how this was to be done. Licensees were required to develop their own joint plan which they needed to submit to Ofcom. Licensees had a ten week window to agree and submit their plan to Ofcom for consideration. Once submitted Ofcom had six weeks to review the proposed joint plan. If no suitable plan was agreed we stated that we would impose our own.

Legal background

- 2.12 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 Wireless Telegraphy Act 2006 (the “2006 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. In Annex 7 we set out in more detail the relevant legal framework, which we have taken into account in making the proposals set out in this document. This annex should be treated as part of this document.

Impact assessment

- 2.13 Section 7 of the Communication Act 2003 (the “2003 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, then 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.
- 2.14 We consider that our proposed changes to the Spectrum Access 800 MHz licences are important for the purposes of section 7 of the 2003 Act. We have made this assessment in light of our statutory duties. On that basis, we are publishing for consultation our proposal to make changes to these licences and our assessment of the likely impact of doing so, to give the licensees and interested third parties an opportunity to make representations.
- 2.15 In preparing this document, we have considered the citizen and consumer interests relating to the Spectrum Access 800 MHz licences. We have also considered the impact of our proposals on the licensees and on existing users in the adjacent spectrum bands. We have also considered whether our proposals would have any impacts on competition.
- 2.16 This document as a whole, including its annexes, comprises an impact assessment as defined in Section 7 of the 2003 Act. Ofcom is an evidence-based organisation and welcomes responses to this consultation. Any comments about our assessment of the impact of our proposals should be sent to us by the closing date for this consultation. We will consider all comments before deciding whether to implement our proposals. For further information

about our approach to impact assessments, see the guidelines ‘Better policy making: Ofcom’s approach to impact assessments’ on our website.¹⁰

Equality impact assessment

- 2.17 Section 149 of the Equality Act 2010 (the 2010 Act) imposes a duty on us, when carrying out our 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 us 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.
- 2.18 Section 75 of the Northern Ireland Act 1998 (the 1998 Act) also imposes a duty on us, when carrying out our 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.
- 2.19 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.
- 2.20 We do not consider that our proposals have any equality implications under the 2010 Act or the 1998 Act.

¹⁰ An overview and link to the guidelines can be found on our [Policies and Guidelines webpage](#).

3. Review of the Spectrum Access 800 MHz licence conditions

3.1 The technical licence conditions for the Spectrum Access 800 MHz licences were set in 2012. These conditions, though technology neutral, were designed to facilitate the implementation of 4G mobile technologies and protect DTT services in the adjacent 700 MHz band. Since we made that decision technology has moved on (e.g. deployment of 5G technology) and the use of the adjacent 700 MHz band has changed. When the 800 MHz band was awarded, DTT was being used in 470 to 790 MHz. Since 2017 DTT has been migrated out to below 694 MHz and in March 2021 703 to 788 MHz was awarded for mobile use. Therefore, the radio environment has changed since the 800 MHz emission limits were set.

Changes requested to the Spectrum Access 800 MHz licence by licensees

3.2 H3G submitted a request to Ofcom in October 2020 to vary its licence by increasing the maximum permitted in-block power from 61 dBm/(5MHz) EIRP to 64 dBm/(5MHz) EIRP irrespective of the number of transmit antennas. A further request was received from BT/EE asking for the same variation to their licence. The two operators requested that condition 7 in Schedule 1 of their respective Spectrum Access 800 MHz licences be amended.

Ofcom review of Spectrum Access 800 MHz technical conditions

3.3 After receiving the requests from the two operators we took the opportunity to review other technical conditions contained in the licences. For this review we looked at the technical conditions of the recently awarded Spectrum Access 700 MHz licences and the assessment work that was carried out as part of that award. We also took into account the fact that most DTT transmitters have been migrated from the 700 MHz band and the adjacent service was now mobile.

3.4 The technical conditions of the licence that we focussed on for the review were:

- the in-block power limit;
- the out-of-block power limits; and
- the out-of-band power limits.

3.5 The review highlighted that the Spectrum Access 800 MHz licences did not include values for some out-of-block and out-of-band transitional limits. Therefore, for clarity and alignment with the harmonised mask from CEPT Report 30, we are proposing to add these as part of these proposed emission limit changes. We do not believe that this change would present any new or additional burden on licensees.

3.6 Our methodology for this work was to use our previous analysis and measurements and re-evaluate them in light of the changes that have occurred since 2012. We also took into

consideration the lessons learnt since the original 800 MHz award was completed and the technical analysis carried out as part of the 700 MHz award.

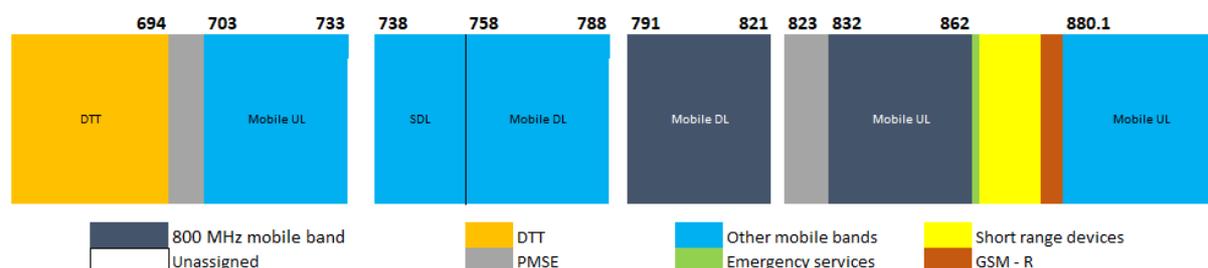
3.7 Our analysis looked at whether any of the proposed changes to the technical licence conditions would still provide adequate protection against undue interference to other spectrum users. With regard to our assessment of undue interference, we have looked at the potential impact on a variety of other users in neighbouring spectrum bands.

3.8 For our analysis of the proposed changes to the 800 MHz emissions limits we considered their impact on the following areas:

- Other mobile services within the 800 MHz band;
- Adjacent services, including Digital Terrestrial Television;
- 700 MHz and 900 MHz mobile;
- Short Range Devices;
- Emergency Services;
- Programme Making and Special Events (PMSE); and
- Global System for Mobile Communications-Railway (GSM-R)
- Potential users of unassigned bands

3.9 Figure 1 shows the adjacent spectrum users to the 800 MHz band that we have considered as part of this work.

Figure 1: The 800 MHz mobile band and adjacent services



3.10 Annex 1 sets out our detailed assessment of the potential risk of interference to a number of services. We have however summarised the findings of this work below.

In-block power limit

3.11 The Spectrum Access 800 MHz licences that we awarded had a maximum in-block transmit power limit of 61 dBm/(5 MHz) EIRP. We defined the maximum EIRP as relating to the EIRP of a specific piece of radio equipment irrespective of the number of transmit antennas. This is set out in Schedule 1 paragraph 9 of the licence.

3.12 When we awarded the 700 MHz licences the maximum transmit power limit was 64 dBm/(5 MHz) EIRP per antenna. Therefore, unlike in 800 MHz, this limit applied to the output from each antenna rather than for a specific piece of radio equipment irrespective of the number of transmit antennas. The in-block power limit is set out in schedule 1 paragraph 7 of the Spectrum Access 700 MHz licence.

- 3.13 Therefore as part of this review, in addition to the 3 dB power increase requested by the two operators we also looked at the impact of the in-block power limit being specified per antenna instead of for a specific piece of radio equipment irrespective of the number of transmit antennas.
- 3.14 Due to the proposed in-block power increase, we also propose that femtocell base stations use power control to minimise interference to adjacent channels. This is also an alignment of the Spectrum Access 800 MHz licences to the Spectrum Access 700 MHz licences.

Interference analysis to other services

Other mobile services within the 800 MHz band

- 3.15 We do not believe there is an undue risk of interference for other users within the 800 MHz band. We expect mobile technologies to be resilient to interference from other mobile technologies within the band and that licensees can resolve any coexistence issues between themselves.
- 3.16 For the full detailed analysis see paragraphs A1.26 to A1.30 of the technical assessment contained in Annex 1.

DTT

- 3.17 DTT services now operate below 694 MHz and there is a significant frequency separation from mobile services operating in the 800 MHz band. The holders of Spectrum Access 700 MHz licences, that operate in the band adjacent to DTT services, have an in-block power limit of 64 dBm/(5 MHz) per antenna which is higher than the current limit in the Spectrum Access 800 MHz licences.
- 3.18 Our assessment is that the vast majority of households would not experience any undue interference as a result of changes to the base station power limits. After carrying out our assessment we believe that there is a small incremental risk of undue interference to DTT households that could be caused by the proposed changes in power. Even without the proposal to apply the limit on per antenna basis, our assessment is that an increase of 3 dB would be sufficient to cause undue interference in some scenarios. Although we expect this impact to be small, we believe that it is sufficient to require action to be taken to resolve it.
- 3.19 We conducted our analysis by reviewing previous work, including measurements, and considering lessons learnt from the original 800 MHz remedial action.
- 3.20 Based on our analysis our main conclusions are that:
- Homes that have already had filters installed or other mitigations to reduce the impact of undue interference from 800 MHz mobile networks to DTT receivers are likely to continue to benefit from good resilience.
 - The increase in transmit power may mean that a small number of households that have been remedied may no longer be protected. Operators would still need to take remedial action against any repeat of undue interference cases, this could mean that they reduce the power of a base station, re-tilt the antenna of a base station, or provide a replacement filter.

- The increase in base station radiated power is likely to result in undue interference to some additional DTT households, noting that we expect some of these households will be already at risk of undue interference from mobile deployments in the recently auctioned 700 MHz band.

- 3.21 We did not model the change in the risk of undue interference because there are several factors with a high degree of uncertainty. These include the very large variability in the quality and performance of individual receive installations which cannot be known in advance.^{11, 12} It is also hard to predict to what extent base station power levels will rise across mobile networks. Furthermore, interference may not be attributable to a power increase in the 800 MHz band alone because we understand that the main mechanisms for interference to DTT equipment are overload and blocking which means that any increased risk of undue interference will be an aggregate of both the power increase in 800 MHz band and the deployment of new mobile networks in 700 MHz band. This is why we based our analysis on the sources we have described above instead.
- 3.22 For the full detailed analysis of the potential impact of DTT see paragraphs A1.31 to A1.53 of the technical assessment contained in Annex 1.

Other adjacent band services

- 3.23 We do not believe there is a risk of undue interference to other services in adjacent bands: PMSE, other mobile services in the 700 MHz and 800 MHz bands, Emergency services, Short Range Devices and GSM-R. For further information see paragraphs A1.54 to A1.75 in Annex 1.

Provisional conclusion on proposed changes to in-block power limits

- 3.24 After assessing the potential impact of changes to the in-block power level, we believe that we should align the in-block power limits for Spectrum Access 800 MHz licences with the limits set out in the Spectrum Access 700 MHz licences. We are therefore proposing that the limit be changed to 64 dBm/(5 MHz) EIRP per antenna.
- 3.25 Based on our analysis we do not believe that the potential risk of undue interference to some DTT households should prevent operators from using higher in-block powers. We also do not believe that changing the limit from *per radio equipment irrespective of the number of transmit antennas* to *per antenna* makes a material difference to the potential interference issues. However, we do believe that operators should have in place a mitigation scheme to resolve any issues for DTT receivers should they occur. The details of this are set out in paragraphs 3.22 to 3.29.

¹¹ Page 13, Coexistence of new services in the 700 MHz band with digital terrestrial television: Consultation, May 2017, https://www.ofcom.org.uk/data/assets/pdf_file/0018/101619/Coexistence-of-new-services-in-the-700-MHz-band-with-digital-terrestrial-television.pdf

¹² Coexistence between LTE and DTT - Practical experience following the clearance and relicensing of 800 MHz spectrum in the UK, [Coexistence between LTE and DTT: Practical experience following the clearance and relicensing of 800 MHz spectrum in the UK - BBC R&D, Nov 2015](#)

Question 1) Do you agree with our proposals to change the in-band power limits contained in the Spectrum Access 800 MHz licences and Ofcom's assessment of the risk of interference? If you disagree, please provide details.

DTT mitigation scheme requirement

- 3.26 Due to the potential undue interference that the increase in power may cause to some DTT viewers, we propose that licensees will be required to set up and operate a scheme to provide advice and assistance to viewers suffering undue interference from mobile services transmitted under the licence and to resolve it.
- 3.27 As discussed above, the recently auctioned Spectrum Access 700 MHz licences require licensees collectively to set up and operate a scheme to assist DTT viewers suffering undue interference as a result of the use of licensed equipment in that band. The 700 MHz licensees have submitted a joint plan to Ofcom for that scheme. Our proposals in this document in relation to the 800 MHz licences would not require any changes to the 700MHz DTT mitigation scheme (although, as discussed below, licensees may wish to consider whether and how the schemes might interact).
- 3.28 In relation to our proposals for the 800 MHz licences, we will not prescribe in detail how the licensees should set up and run their schemes. Our proposed approach would be to notify the licensee, under Schedule 1 paragraph 4 of the licence, of the requirement to produce a plan that sets out how they would mitigate and resolve any interference should it arise. Ofcom will need to review the plan prior to the commencement of transmissions at the higher power limits irrespective of the number of antennas.
- 3.29 An indication of what we expect to see in a plan is provided in the form of guidance, set out in Annex 3 of the 700 MHz award Information Memorandum.¹³ This sets out that a plan must make provisions in at least the following areas.
- Engaging with consumers – Licensees need to make appropriate provision for informing consumers at risk of being affected by interference. We expect licensees to provide an advice line and to advertise that help is available.
 - Assisting consumers who experience problems – Licensees need to assist consumers who experience interference resulting from mobile in the 800 MHz band.
 - Helping vulnerable consumers – Licensees need to take account of the needs of vulnerable consumers.
 - Operational functions – Licensees have to take account of the operational side of supporting DTT viewers. This includes how the costs of viewer support is funded and how performance is tracked.
- 3.30 We are proposing that the use of higher in-band power limits over what is currently allowed in the licence,¹⁴ will only be permitted once a scheme has been set up. We have the power to

¹³ Award of the 700 MHz and 3.6-3.8 GHz spectrum bands Information Memorandum https://www.ofcom.org.uk/data/assets/pdf_file/0019/192412/information-memorandum-award-700mhz-3.6-3.8ghz-spectrum.pdf published 13 March 2020

¹⁴ This includes where the overall emission limit would exceed 61 dBm/(5 MHz) EIRP per radio equipment.

take enforcement action, including imposing financial penalties assessed in light of Ofcom's penalty guidelines,¹⁵ against licensees who do not comply with their licence conditions.

- 3.31 There is no time limit within which a licensee would need to submit their plan to Ofcom however, as set out above they will not be able to transmit at these higher powers until a scheme has been reviewed by Ofcom and is operational. We will acknowledge any plan in accordance with the objective that 800 MHz band mobile services do not cause undue interference to DTT viewers – and, if they do, that the licensee takes appropriate and proportionate measures to address any undue interference.
- 3.32 As with the Spectrum Access 700 MHz licences, the responsibility to manage the impact of any incoming interference received by viewers watching services transmitted in the 738 to 758 MHz centre gap would sit with Arqiva. We are not therefore proposing to require any viewer support scheme run by Spectrum Access 800 MHz licensees to provide assistance to viewers who may lose services carried by the interim multiplexes.
- 3.33 A licensee may choose to combine this scheme with the existing at800 scheme, choose to include as part of their 700 MHz scheme or create a new one. We will leave this decision up to the operators.
- 3.34 If a licensee chooses not to take advantage of the proposed power increase that would be set out in their licence and instead continues to transmit at the current limit of 61 dBm/ (5 MHz) EIRP radio equipment, they will not need to be part of a scheme.¹⁶ If in the future they wish to use the increased in-band power they will need to have one in place before transmitting.
- 3.35 We plan to implement this requirement by issuing a notice to licensees under Schedule 1 paragraph 4 of the licence.

Question 2) Do you agree with our proposals to require licensees to have in place a mitigation scheme to resolve any DTT issues should they occur? If not, please provide details.

Out-of-band and out-of-block emission limits

- 3.36 The Spectrum Access 800 MHz licence also includes out-of-block and out-of-band emission limits to ensure compatibility with similar services using the same spectrum band and other services in nearby spectrum bands. These are defined as follows:
- **Out-of-block emissions limits** apply outside of a licensee's permitted frequency block but within the 800 MHz downlink band (791 to 821 MHz); and
 - **Out-of-band emissions limits** apply outside of the 800 MHz downlink band (below 791 MHz and above 821 MHz). Out-of-band emissions limits are broken down further into two categories:

¹⁵ The current version of Ofcom's penalty guidelines is available at https://www.ofcom.org.uk/data/assets/pdf_file/0022/106267/Penalty-Guidelines-September-2017.pdf

¹⁶ Requirements under the existing 800 MHz rollout mitigation scheme notified to licensees would still continue.

- **Baseline out-of-band emissions limits** which apply to most out-of-band frequencies; and
- **Transitional out-of-band emissions limits** which describe how emissions should reduce from in-band power levels down to the baseline out-of-band emissions limits.

3.37 The 800 MHz Decision provided a range of out-of-band limits below 790 MHz that Member States were free to adopt depending on their national circumstances, depending on whether existing or future DTT use was to be protected.¹⁷

3.38 When the 800 MHz band was first awarded in 2012, the UK had DTT services that we wanted to protect below 790 MHz and so we introduced the limits necessary to protect this use. This corresponded to the most stringent case set out in the 800 MHz Decision.

3.39 The current Spectrum Access 800 MHz licences do not contain transitional out-of-band limits for 790 to 791 MHz and 821 to 832 MHz and transitional out-of-block limits for 791 to 821 MHz.

3.40 The Spectrum Access 700 MHz licences included a different set of out-of-block and out-of-band conditions that users must adhere to which were taken from the 700 MHz Decision. Again, similar to the 800 MHz Decision, it set out a range of limits depending on national circumstances. This also included whether EU Member States were going to use the 733 to 736 and/or 788 to 791 MHz bands for PPDR or M2M.

3.41 Table 1 shows the current permitted out-of-block and out-of-band emission limits in 700 MHz compared to the 800 MHz band.

¹⁷ 800 MHz Decision Annex Table 4

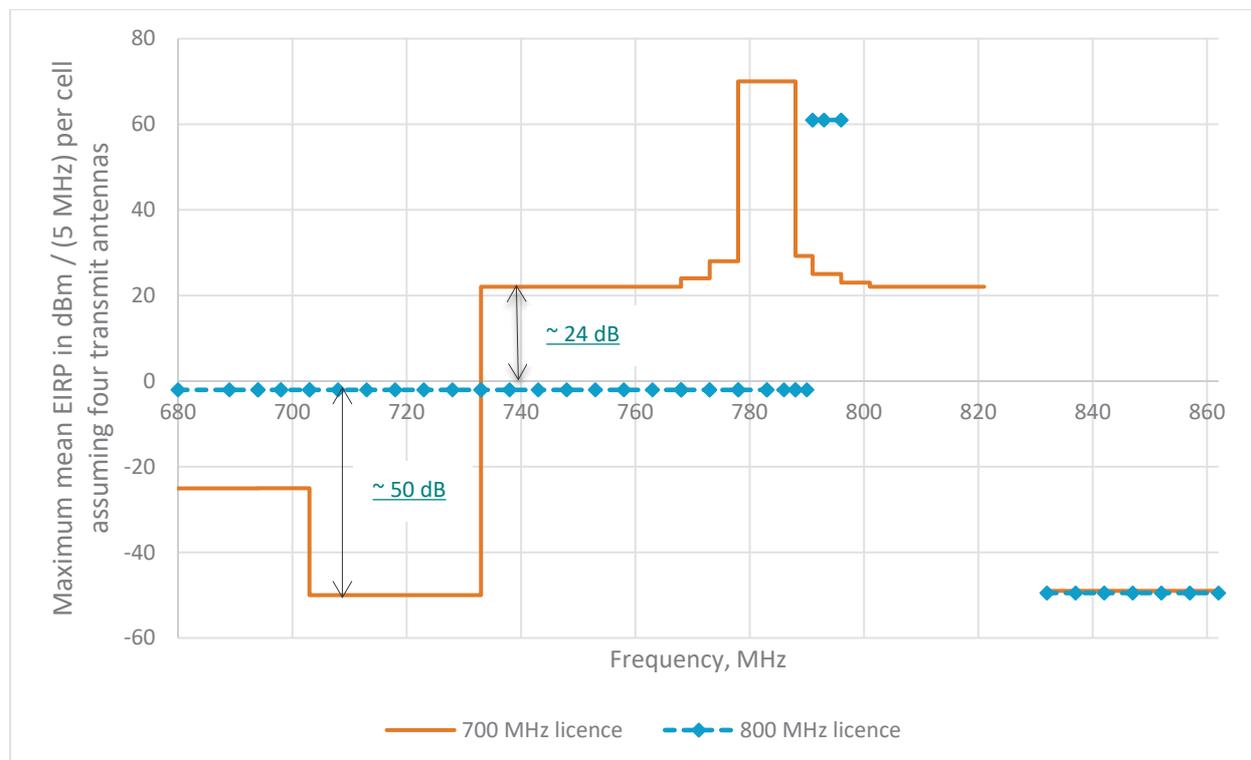
Table 1: Spectrum Access 700 MHz and 800 MHz licence out-of-block and out-of-band emission limits

Frequency Range	Existing 800 MHz licences maximum mean EIRP limit	700 MHz licences maximum mean EIRP limit
470 – 694 MHz	0* dBm /(8 MHz)	-23 dBm /(8 MHz) per cell
694 – 703 MHz	relates to a specific piece of equipment irrespective of the number of transmit antennas.	-32 dBm /(1 MHz) per cell
703 – 733 MHz		-50 dBm /(5 MHz) per cell
733 – 788 MHz		16 dBm /(5 MHz) per antenna baseline limit
788 – 790 MHz		14 dBm /(3 MHz) per antenna
790 – 791 MHz	N/A	
791 – 821 MHz	N/A	16 dBm /(5 MHz) per antenna
821 – 832 MHz	N/A	N/A
832 – 862 MHz	-49.5 dBm /(5 MHz) relates to a specific piece of equipment irrespective of the number of transmit antennas.	-49 dBm /(5 MHz) per cell

**This assumes the base station is transmitting at the maximum in-block power limit. Lower limits apply if the in-block power is lower (see Annex A2, schedule 1, table in paragraph 9a of the draft licence).*

3.42 Figure 2 below compares the current downlink emissions limits contained in both the 700 MHz and 800 MHz licences. For illustrative purposes we have chosen to compare the two adjacent licences in the 700 MHz and 800 MHz bands. These being BT/EE's 700 MHz licence at 778 to 788 MHz and H3G's 800 MHz licence at 791 to 796 MHz.

Figure 2: Comparison of maximum downlink emissions allowed in BT/EE's Spectrum Access 700 MHz licence and H3G's current Spectrum Access 800 MHz licence



Proposed out-of-block and out-of-band emissions limits changes

- 3.43 As can be seen in Table 1 and Figure 2 above, there are a number of areas where the emissions limits differ between the 700 MHz and current 800 MHz licences. For this review, we considered whether we could relax the 800 MHz conditions where the 700 MHz were more permissive. We did not consider being more restrictive as this could have an impact on equipment that has already been deployed and operating for a number of years without causing undue interference.
- 3.44 Figure 2 shows that for some frequencies the Spectrum Access 800 MHz licence does not set an out-of-block or out-of-band transitional limits. As part of our review, we are proposing to introduce limits that align with those from the 800 MHz mask set out in the CEPT Report 30.
- 3.45 We propose to define these limits using *per antenna* limits as set out in the CEPT mask, but without the restriction limiting systems to one to four antennas. For the Spectrum Access 700 MHz licences we decided no limit on the number of antennas was needed. As no such restriction is in place on users of the 700 MHz band we do not consider it necessary to include it as a condition in the Spectrum Access 800 MHz licence.
- 3.46 In practice, we do not expect antenna systems in 800 MHz to exceed four transmit antennas in the short to medium term and the use of antenna systems using more than four transmit antennas remains uncertain in the longer term. We discuss this in more detail in paragraphs A1.16 to A1.19 of the Annex 1. If widespread deployment of more than four antennas was to

occur then we may need to reconsider our coexistence assessment. This may require further changes to be placed on licensees in order to protect other users.

3.47 We propose relaxing the out-of-band emissions limits in 733 to 790 MHz. We observed that there was a very steep roll off in the Spectrum Access 800 MHz licences at the 790 MHz band edge. This was originally put in the licences in order to protect DTT below 790 MHz, however, DTT no longer operates in 694 to 790 MHz. Therefore we are proposing to relax the out-of-band emissions limits in 733 to 790 MHz. We do not see the need to relax the out-of-band emissions limits in 694 to 733 MHz because the emissions limits for the Spectrum Access 800 MHz licences are already more relaxed than the emissions limits for Spectrum Access 700 MHz licences in 694 to 733 MHz. Our proposed relaxation consists of two parts:

- We are proposing to raise the baseline emissions limit in 733 to 790 MHz to the same as that in the Spectrum Access 700 MHz licences.
- We are proposing a further relaxation for licensees with permitted frequency blocks in 791 to 801 MHz by adding new transitional limits in 778 to 791 MHz for those licensees. These transitional limits mirror the out-of-band transitional limits in 788 to 801 MHz in the Spectrum Access 700 MHz licences for licensees with permitted frequency blocks in 778 to 788 MHz.

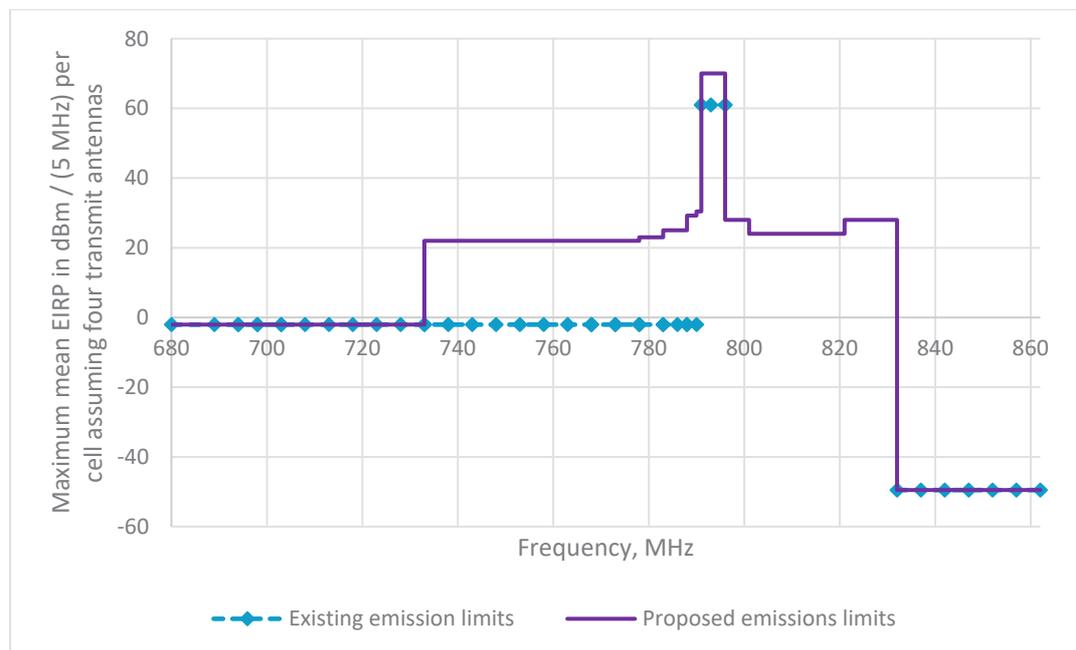
3.48 Table 2 and Figure 3 set out the changes we are proposing to make.

Table 2: Existing and proposed 800 MHz out-of-block and out-of-band emissions limits

Frequency Range	Existing 800 MHz licences maximum mean EIRP limit	Our proposed 800 MHz maximum mean EIRP limit	
470 – 694 MHz	0* dBm /(8 MHz)	0* dBm / (8 MHz)	
694 - 703 MHz	relates to a specific piece of equipment irrespective of the number of transmit antennas.	relates to a specific piece of equipment irrespective of the number of transmit antennas.	
703 – 733 MHz			
733 – 788 MHz			16 dBm /(5 MHz) per antenna
788 – 790 MHz			12 dBm /(2 MHz) per antenna
790 – 791 MHz	N/A	17.4 dBm /(1 MHz) per antenna	
791 – 821 MHz	N/A	11 dBm /(1 MHz) per antenna baseline limit	
821 – 832 MHz	N/A	15 dBm /(1 MHz) per antenna	
832 – 862 MHz	-49.5 dBm /(5 MHz) relates to a specific piece of equipment irrespective of the number of transmit antennas.	-49.5 dBm /(5 MHz) relates to a specific piece of equipment irrespective of the number of transmit antennas.	

**This assumes the base station is transmitting at the maximum in-block power limit. Lower limits apply if the in-block power is lower (see Annex A2, schedule 1, table in paragraph 9(a) of the draft licence).*

Figure 3: Comparison of the existing 800 MHz downlink emissions limits and the proposed 800 MHz downlink emissions limits. H3G’s block in 791-796 MHz has been used for this illustration.



Interference analysis to other services

3.49 In Annex 1 we look in more detail at the impact of changing the permitted emissions limits on other services. A summary of the conclusions of this work is set out below.

Mobile services

3.50 We looked at the impact on mobile services in the 700 MHz band. The band 738 to 788 MHz is used for mobile downlink (base station transmit and mobile receive) and 703 to 733 MHz is used for mobile uplink (mobile transmit and base station receive).

3.51 The European Conference of Postal and Telecommunications Administrations (CEPT) studied what would be the appropriate technical licence conditions for mobile use across Europe for the 700 MHz band. It produced CEPT Report 53,¹⁸ which also considered the compatibility of the 700 MHz and 800 MHz band together. It stated that, as a consequence of the 700 MHz base station transmit band being adjacent to the 800 MHz base station transmit band (avoiding adjacency between base stations and terminal stations) there is compatibility between the existing 790 to 862 MHz channelling arrangement and the channelling arrangement for the 694 to 790 MHz band.

3.52 We note that the current out-of-band limits for the Spectrum Access 800 MHz licences are not as restrictive as those in the 700 MHz mobile uplink band (703 MHz to 733 MHz). The Spectrum Access 700 MHz licences have an emission level ~50dB lower to protect the mobile uplink from their mobile downlink. However, as CEPT have already concluded the channelling arrangements are compatible we do not believe that maintaining the current limits would

¹⁸ CEPT Report 53 <https://docdb.cept.org/download/86> published 28 November 2014

result in undue interference. If there were any concerns raised about the 800 MHz out-of-band limits we would have expected these to have been found as part of CEPT and Ofcom's technical analysis when preparing for the allocation of 700 MHz for mobile services.

- 3.53 We expect mobile technologies to be resilient to interference from other mobile technologies within the band and that licensees can resolve any coexistence issues between themselves
- 3.54 Based on our analysis we do not believe that the proposed relaxation of the out-of-band requirements would impact on mobile services in the adjacent 700 MHz band.

DTT

- 3.55 Our review of the studies into mobile interference to DTT found that the dominant interference mechanisms to DTT equipment was blocking and overloading. Therefore, the out-of-band emission levels from 800 MHz base stations to DTT are not the dominant cause of undue interference into DTT, so it is not necessary to make the out-of-band emission limits more restrictive in the DTT band. We discuss this in more detail in the technical annex to this consultation.

PMSE (821 to 832 MHz)

- 3.56 No out-of-band emissions limits are currently set in the Spectrum Access 800 MHz licences. We propose to introduce limits aligned with those set out in the 800 MHz mask set out in CEPT Report 30. We expect this proposal to have no impact of coexistence with PMSE.

Emergency Services, SRDs and GSM-R

- 3.57 No out-of-band emissions limits are set in the Spectrum Access 800 MHz licences for the bands with Emergency Services, SRDs and GSM-R. We are not aware of there being significant undue interference from the Spectrum Access 800 MHz licences, so we do not see it is necessary to put in additional restrictions to protect these services.

Future use of unassigned bands

- 3.58 The frequency bands 733 to 738 MHz and 788 to 791 MHz are not currently assigned but may be used in the future. CEPT Report 53 proposed two options for these bands PPDR and M2M communications.
- 3.59 The protection level we propose for these bands mirrors what we offer from the 700 MHz band. Therefore both the 700 MHz and the 800 MHz emissions into the band will be similar. This would give any potential future use slightly less protection than it would have currently but it does not significantly alter the current potential utility of the band due to the existing emission limits from the 700 MHz band.

Provisional conclusion on the proposed changes to the out-of-band and out-of-block emission limits

- 3.60 We provisionally conclude that our proposed changes to the out-of-band and out-of-block emissions limits for Spectrum Access 800 MHz licensees will not result in undue interference to users in the 800 MHz band or in the adjacent bands. We provisionally conclude that our proposed changes will not materially restrict the ability of Spectrum Access 800 MHz

licensees to deploy mobile base stations. We therefore are proposing to make changes to the emission limits as we set out in Table 2 above.

Question 3) Do you agree with the proposals to relax the out-of-band emission limits? If you disagree, please provide details.

Question 4) Do you agree with the proposals to add the transitional out-of-band and out-of-block emission limits? If you disagree, please provide details.

Question 5) Do you have any further comments on the technical assessment carried out by Ofcom in Annex 1 of this document?

4. Assessment of proposed changes

4.1 In this section we set out our assessment of the proposed changes to the Spectrum Access 800 MHz licences as a result of our licence review, these include:

- Aligning the in-block power limit with the recently awarded 700 MHz band subject to a requirement to have in place a mitigation scheme to protect DTT viewers should interference arise;
- Relaxing the out-of-band limits in 733 to 790 MHz; and

Introduce limits to align the out-of-band and out-of-block limits between 790 to 791, 821 to 832 MHz and 791 to 821 MHz with the 800 MHz mask set out in CEPT Report 30. Ofcom's assessment framework

4.2 The radio spectrum is a finite national resource of considerable economic and social value. In considering the variation of individual licences we take into account our duties and, in light of those duties, the factors that we take into account include:

- securing optimal spectrum use;
- the impact on spectrum users in the same and adjacent bands;
- promoting competition;
- encouraging innovation and investment; and
- benefits for consumers and citizens.

4.3 In reaching our provisional conclusion, we have had to balance the advantages and disadvantages of updating the licences, in light of the relevant factors and evidence, in order to reach an outcome that most appropriately meets our relevant statutory duties.

4.4 We have considered both the likely impact on competition of making these changes and the likely impact on spectrum management, in particular the impact on existing licensed or exempted users of the adjacent spectrum bands.

Initial assessment

Securing optimal use of spectrum

4.5 In securing our principal duty to further the interests of citizens in relation to communications matters and consumers in relevant markets, we are further required to secure the optimal use for wireless telegraphy of the electro-magnetic spectrum.

4.6 Ofcom's general policy is to set technical restrictions that are the minimum necessary to provide adequate protection against undue interference. This is because optimal use of the radio spectrum is more likely to be secured if users decide, rather than Ofcom dictates, the way in which technology is used or a service is provided in a particular frequency band.

Imposing the minimum necessary constraints will increase users' flexibility and freedom to respond to changing conditions and to make best use of the valuable spectrum resource.

- 4.7 In order to expand capacity operators can add more spectrum to their existing network, increase the number of transmission sites or improve how efficiently they use their existing spectrum. One way of improving efficiency is to increase the number of antennas on a site. The proposed in-block power increase has been requested by one operator specifically to enable them to move from a system using two transmit antennas and two receive antennas (2T2R); to a system that will use four transmit antennas and four receive antennas (4T4R). The use of more antennas reduces the need for an operator to require additional spectrum and is an efficient use of their existing spectrum resources.
- 4.8 Licensees are able to increase the number of antennas under their current in-power limits however, this would have the effect of reducing the existing coverage of a cell. This is due to the power limit being set for the total transmission of all the radio equipment irrespective of the number of antennas, meaning that in order to double the number of antennas the power supplied to each would need to be halved (e.g. 4 x 10 Watts for the four antennas instead of 2 x 20 Watts for the 2 antenna). Our proposed changes should provide better coverage and in-building penetration for existing equipment, as the higher power is able to overcome some of the building entry losses caused by the building.

Impact of proposed licence changes on other users of the radio spectrum

- 4.9 Our technical analysis in Annex 1 has shown that, other than DTT, no other users should be adversely affected by the proposed changes to the Spectrum Access 800 MHz licence. However, we believe that the increased risk of undue interference to DTT can be mitigated by requiring those companies that wish to transmit at the higher permitted powers to resolve any problems should they arise. This approach has been adopted in respect to the original rollout of 800 MHz services and will also be used for future 700 MHz deployments.

Promote competition

- 4.10 We have a principal duty to further the interests of citizens in relation to communications matters and to further the interests of consumers in relevant markets, where appropriate by promoting competition. We believe the UK market for mobile services is generally operating well with continuing innovation and relatively low prices compared to other markets internationally.
- 4.11 Our proposed changes would align the in-block power, out-of-block and out-of-band limits where appropriate with the licences granted as part of the 700 MHz award.
- 4.12 As part of our work on the 700 MHz award we considered the potential competition concerns relating to the asymmetries in low frequency spectrum.¹⁹ In that work we showed that the coverage potential for 800 MHz is currently less than that of other low frequency

¹⁹ Annex 6 https://www.ofcom.org.uk/data/assets/pdf_file/0017/192410/annexes-award-700mhz-3.6-3.8ghz-spectrum.pdf

spectrum. The increase in the in-block power limit may make it easier for 800 MHz licensees to match the coverage of other low frequency bands such as 700, 900 and 1400 MHz.

- 4.13 Our proposed changes could apply to licences held by all four mobile operators. Therefore, we do not consider that they would have an adverse impact on competition between MNOs or any other licensees in the 700, 800, 900 or 1400 MHz bands.
- 4.14 Finally, we have considered whether the proposed changes would have an adverse competitive impact on other spectrum users, and have provisionally concluded that they would not. The proposed changes to technical conditions should not impact the spectrum quality of existing deployments in or adjacent to the 800 MHz band.

Licence fees

- 4.15 Licence fees for Spectrum Access licences are generally calculated with reference to the amount of spectrum held and the geographic extent of the spectrum authorisation. The proposed licence changes do not involve altering these parameters and would therefore have no impact on licence fees. We also note that the licences awarded in 2013 have an initial duration of 20 years (i.e. 2033) before fees would be applicable.

Encouraging innovation and investment

- 4.16 We have also had regard to the economic and other benefits that may arise from the use of this spectrum, and the need to encourage the development of innovative services. The variation to the permitted in-block power level from 61 dBm to 64 dBm has been requested to enable the deployment of advanced technologies such as LTE-advanced and potential 5G in the future.
- 4.17 In addition to increasing capacity and coverage to meet demand for services delivered via existing mobile networks, there is the potential for this spectrum to be used for 5G services in the future.²⁰ Further deployment of LTE-advanced or 5G services has the potential to deliver benefits for UK consumers and businesses, including superfast broadband, greatly expanded capacity and innovative new services.
- 4.18 The 800 MHz band has properties and characteristics that make them particularly suitable for mobile broadband use, including latest technologies. We consider it important that operators are able to make full use of the band so that they can meet consumer demand, particularly for increasing capacity for mobile broadband services, improve coverage, and enable the industry to take advantage of innovation opportunities.
- 4.19 In addition, our further proposal to harmonise the technical conditions with the 700 MHz bands would mean that licensees would have the same in-block power limits apply to all the spectrum they hold in 700 MHz and 800 MHz. It has been highlighted to us, that the current out-of-band emission mask below 790 MHz can make it difficult to build base station equipment which transmits in both the 700 MHz and 800 MHz bands. There is a desire from equipment suppliers to build a single base station that can be used for the 700 MHz and 800

²⁰ 800 MHz band is designated by the 5G New Radio (NR) standard as band n20

MHz band together due to the proximity of the downlink frequency bands. Our proposed changes may make it easier and potential cheaper for operators to roll out in both bands.

Benefit to citizens and consumers

- 4.20 Spectrum is a scarce and valuable resource. These licences are of direct public benefit because they ensure that citizens, consumers and businesses can all realise the greatest available value from use of the frequencies.
- 4.21 Consumers should benefit from the proposed changes, as they are likely to lead to higher quality enhanced mobile broadband services being available, due to licensees being able to use the spectrum they have more optimally.
- 4.22 The move to more efficient antenna technologies will enable deployment of LTE-advanced and other technologies. Even without the antenna upgrades the increased power to existing equipment would still help increase indoor and deep indoor geographic coverage over the UK.
- 4.23 As we are proposing to apply this change to all Spectrum Access 800 MHz licensees, we would expect to see these benefits apply to customers of all networks that decide to take advantage of the proposed power increase.

EMF and health concerns

- 4.24 In October 2020, we published a statement setting out our decision to formally incorporate the relevant limits in the International Commission for Non-Ionising Radiation Protection (ICNIRP) guidelines on limiting exposure to electromagnetic fields (EMF) (the “ICNIRP Guidelines”)²¹ into our spectrum licences, following a public consultation process.²²
- 4.25 This requirement applies to all 2006 Act licence classes which authorise equipment to transmit at powers above 10 Watts EIRP. We received a significant number of comments in response to our proposals in relation to health concerns which we addressed during that consultation process.²³ Whilst we have seen no evidence that spectrum users are operating radio equipment in breach of the ICNIRP general public limits, the licence condition we have imposed sets out a clear requirement on licensees to ensure services operate in a way which will not adversely affect peoples’ health. It also puts Ofcom in a position where we can take appropriate enforcement action in the event the ICNIRP general public limits are breached.
- 4.26 Ofcom has been carrying out radio frequency EMF measurements near mobile phone base stations for many years.²⁴ These measurements have consistently shown these are well within the internationally agreed levels published in the ICNIRP Guidelines. In March 2021

²¹ <https://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf>

²² See our Statement on “[Measures to require compliance with international guidelines for limiting exposure to electromagnetic fields \(EMF\)](#)” dated 5 October 2020 (“EMF Statement”) and “[Update on implementation of measures to require compliance with international guidelines for limiting exposure to electromagnetic fields \(EMF\)](#)” dated 1 March 2021 (“EMF Update”).

²³ See section 3 of both our EMF Statement and our EMF Update.

²⁴ Ofcom inherited a programme of EMF measurements started by its predecessor, the Radiocommunications Agency (one of the five regulators whose duties were subsumed by Ofcom when it was created).

we published the latest update to our summary of results from measurements taken near 5G base stations.²⁵ These results show that, at all locations where we have conducted measurements, the EMF levels are at small fractions of the maximum levels identified in the ICNIRP Guidelines. We continue to monitor the EMF levels and publish the results regularly.²⁶

- 4.27 We expect that, as a result of these proposed changes, the emission limits will remain well within the levels that we have set. Licensees will continue to not be allowed to exceed the internationally agreed exposure levels for the protection of the general public and there should therefore be no EMF implications for public health.

Provisional conclusion

- 4.28 We have considered the requested licence variation and our further proposals in light of our relevant licensing functions and statutory duties. Our provisional conclusion, which is subject to this consultation, is that it is appropriate to update the technical conditions contained in the Spectrum Access 800 MHz licences as we have proposed.
- 4.29 The proposed changes are shown in a draft marked-up version of Spectrum Access 800 licence, attached as Annex A2.
- 4.30 Our assessment is based on operators deploying existing 2T2R or 4T4R antenna technologies. If in the future, licensees consider the deployment of systems comprising of a significantly larger number of transmits antennas we may need to review our assessment. We note that the block edge mask power limits specified in the 800 MHz Decision apply for antenna systems with between one and four antennas. If, in future, systems with a larger number of transmit antennas are deployed, Ofcom may decide to take appropriate action to ensure that the potential risk of interference to other users is mitigated.
- 4.31 We do note the risk of undue interference to some existing DTT equipment in certain scenarios. However, we do not believe that this should be a barrier to making our proposed changes providing that appropriate mitigation schemes are put in place by licensees to resolve any issues should they arise. Our proposal to allow increased in-band power is subject to licensees establishing and operating a scheme to provide advice and assistance to DTT viewers suffering undue interference. Our proposed requirement for the DTT mitigation scheme is not a result of our additional proposal to align the in-band power limit to *per antenna*, instead of being specified *irrespective of the number of antennas*.
- 4.32 As shown by our technical analysis we would have proposed this requirement in relation to the original requested 3 dBm power increase from the two operators.
- 4.33 Overall, we believe that consumers are likely to benefit from the proposed licence variations from higher quality of innovative mobile services being available and through the optimal

²⁵ Electromagnetic Field (EMF) measurements near 5G mobile phone base stations Summary of results https://www.ofcom.org.uk/data/assets/pdf_file/0021/214644/emf-test-summary-010321.pdf updated 1 March 2021

²⁶ Mobile phone base station audit results

<https://www.ofcom.org.uk/spectrum/information/mobile-operational-enquiries/mobile-base-station-audits>

spectrum use on the part of licensees. Consumers may also benefit from these services providing faster download speeds and improved coverage.

- 4.34 In our view, our proposed changes to the Spectrum Access 800 MHz licences are:
- **objectively justified** in that they would enable optimal use of spectrum and encourage investment and innovation in the services that can be deployed in the 800 MHz band, whilst also addressing the risks of undue interference that might otherwise arise from the proposed permitted increase in power;
 - **not unduly discriminatory** against particular persons or against a particular description of persons, in that these proposed changes would apply to all holders of Spectrum Access 800 MHz licences;
 - **proportionate** to what they are intended to achieve, in that we are updating several conditions to make them less restrictive to take account of changes in market conditions since the licences were issued, and are proposing to impose mitigation requirements which are the minimum necessary to provide adequate protection against undue interference; and
 - **transparent in relation to what they are intended to achieve**, in that the proposals, and our underlying objectives and reasoning, are described and explained in this consultation document.
- 4.35 We consider that our proposed changes would further the performance of our general duties in section 3 of the 2003 Act, as citizens and consumers will likely benefit from better mobile coverage, higher quality enhanced mobile broadband services and optimal use of spectrum. We describe above the factors we have taken into account in reaching our provisional conclusion, which reflect the matters set out in section 3 of the 2006 Act and (insofar as they are relevant) in section 3 of the 2003 Act, and the requirements of section 4 of the 2003 Act.

Question 6) Do you agree with Ofcom's assessment on whether to change the emissions limits of the Spectrum Access 800 MHz licences? If you disagree, please provide further information.

Views sought

- 4.36 We are giving stakeholders until **5pm on 7 September 2021** to provide comments on the following questions.

Question 1) Do you agree with our proposals to change the in-band power limits contained in the Spectrum Access 800 MHz licence and Ofcom's assessment of the risk of interference? If you disagree, please provide details.

Question 2) Do you agree with our proposals to require licensees to have in place a mitigation scheme to resolve any DTT issues should they occur? If not, please provide details.

Question 3) Do you agree with the proposals to relax the out-of-band emission limits? If you disagree, please provide details.

Question 4) Do you agree with the proposals to add the transitional out-of-band and out-of-block emission limits? If you disagree, please provide details.

Question 5) Do you have any further comments on the technical assessment carried out by Ofcom in Annex 1 of this document

Question 6) Do you agree with Ofcom's assessment on whether to change the emissions limits of the Spectrum Access 800 MHz licences? If you disagree, please provide further information.

Next steps

- 4.37 After considering responses to this consultation we will publish a decision. As required by the 2006 Act, if we wish to proceed with varying the licences, we will need to follow the process as set out in Schedule 1. Further information on this is provided in Annex 7.

A1. Technical Annex

Introduction

- A1.1 This annex considers how the proposed licence variations might impact coexistence with other services. We have structured this as follows:
- **Proposed changes** in which we discuss the proposed licence variations including the in-block and the out-of-block and out-of-band changes.
 - **Potential impact** of the in-band power increase on the radio environment including considering the antenna systems used and network planning principals.
 - **Compatibility** in which we consider the impact of the licence variations on coexistence with services within and adjacent to the 800 MHz band. These services are:
 - Other mobile services within the 800 MHz band;
 - Adjacent services, including Digital Terrestrial Television;
 - 700 MHz and 900 MHz mobile;
 - Short Range Devices;
 - Emergency Services;
 - Programme Making and Special Events (PMSE); and
 - Global System for Mobile Communications-Railway (GSM-R)
 - Potential future users of unassigned bands

Proposed changes

- A1.2 In this section we discuss:
- The requested in-block power limits;
 - The additional change to the in-block power limits that we are proposing; and
 - The additional changes to the out-of-block and out-of-band power limits that we are proposing

Requested In-block power limits

- A1.3 H3G and BT/EE have both requested that their 800 MHz licences be varied so that the maximum power within their permitted frequency blocks be increased by 3 dB from 61 dBm/(5 MHz) EIRP to 64 dBm/(5 MHz) EIRP. This limit applied for a specific piece of radio equipment irrespective of the number of transmit antennas .
- A1.4 We understand that the licensees wish to upgrade from a two antenna two receiver (2T2R) to four antenna four receiver (4T4R) antenna systems to increase the capabilities of their network. We understand that the current power limit of 61 dBm/(5 MHz) EIRP^{Error! Bookmark not defined.} may be restrictive in some circumstances. For example, if a licensee is already transmitting at the current power limit but wishes to double the number of antennas in each cell from two to four.

The additional change to the in-block power limits that we are proposing

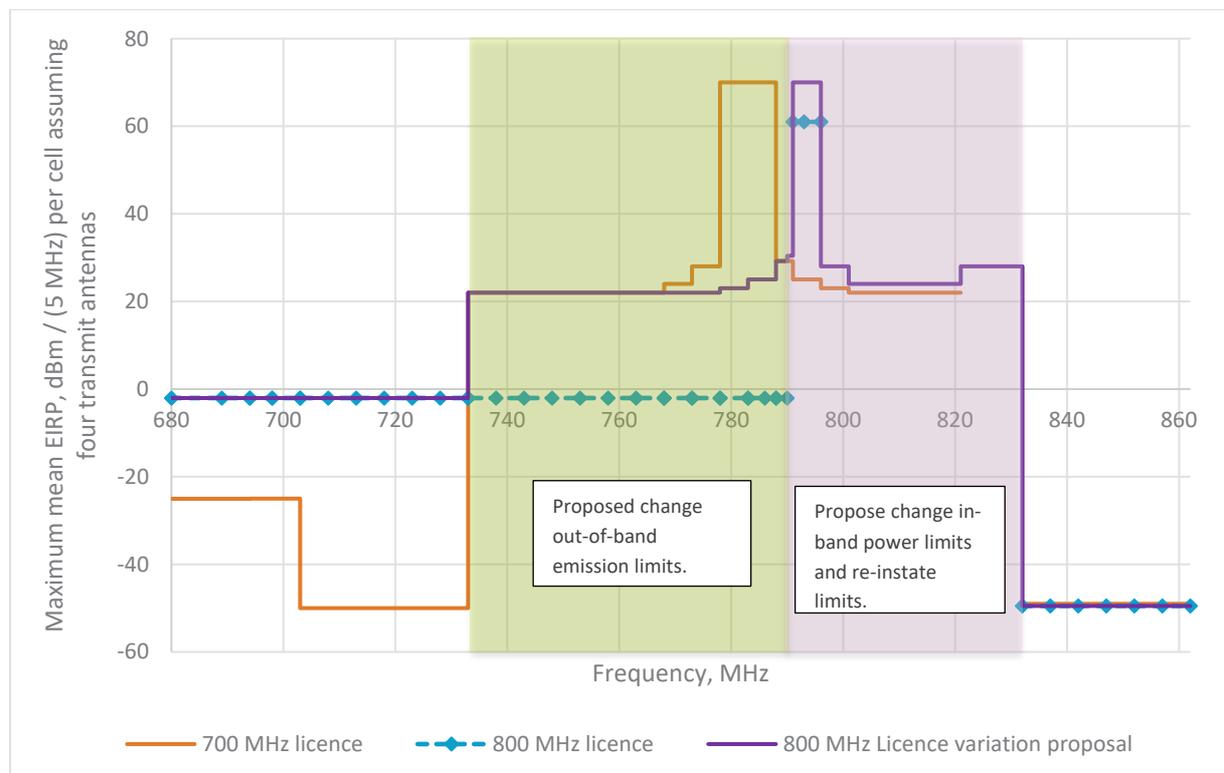
- A1.5 In addition to the 3 dB power increase requested by the two operators we also looked at the impact of the in-block power limit being specified per antenna instead of for a specific piece of radio equipment irrespective of the number of transmit antennas.
- A1.6 This would mean that the new in-block power limits in all of the Spectrum Access 800 MHz licences would become “64 dBm/(5 MHz) EIRP per antenna”.

The additional changes to the out-of-block and out-of-band power limits that we are proposing

- A1.7 The additional changes to the out-of-block and out-of-band power limits are summarised below:
- A proposal of relaxing the out-of-band limits in 733 to 790 MHz, which includes:
 - a) Relaxing the maximum baseline emissions limits in 733 to 790 MHz (through 700 MHz downlink, the supplementary downlink (SDL) band and the duplex gap) to the same baseline emissions limits as in the 700 MHz licences
 - b) A further relaxation for licensees with permitted frequency blocks in 791 to 801 MHz by adding new transitional limits in 778 to 791 MHz for those licensees. These transitional limits mirror the out-of-band transitional limits in 788 to 801 MHz in the Spectrum Access 700 MHz licences for licensees with permitted frequency blocks in 778 to 788 MHz.
- A1.8 Aligning the out-of-band and out-of-block limits between 790 to 791, 821 to 832 MHz and 791 to 821 MHz with the European Conference of Postal and Telecommunications Administrations (CEPT) mask set out in Report 30.²⁷ The out-of-band and out-of-block transitional limits were defined using *per antenna* limits when the Spectrum Access 800 MHz licences were first issued and were specified for antenna systems using one to four antennas. We propose to define these limits using *per antenna* limits as before, but without the restriction limiting antenna systems to one to four antennas.
- A1.9 Figure A1: below shows:
- A broken blue line which shows the existing emissions limit for the 800 MHz downlink. H3G’s spectrum block in 791-796 MHz has been used for this illustration;
 - A solid purple line which shows our proposed emissions limit for the 800 MHz downlink. H3G’s spectrum block in 791-796 MHz has been used for this illustration; and
 - A solid orange line which shows the existing regulatory emissions limit for the 700 MHz downlink. BT/EE’s spectrum block in 778-788 MHz has been used for this illustration.

²⁷ CEPT Report 30 “The identification of common and minimal (least restrictive) technical conditions for 790 - 862 MHz for the digital dividend in the European Union”, published 30 October 2009 <https://docdb.cept.org/download/41>

Figure A1: Comparison of maximum downlink emissions allowed in BT/EE's Spectrum Access 700 MHz licence, H3G's current and proposed Spectrum Access 800 MHz licence.



Potential impact of the in-band power increase on the radio environment

A1.10 We understand that the licensees wish to upgrade from 2T2R to 4T4R antenna systems to increase the capabilities of their network. We understand that the current power limit of 61 dBm/(5 MHz) EIRP^{Error! Bookmark not defined.} may be restrictive in some circumstances. In this section we discuss the potential impact on the radio environment of the proposed in-block power increase considering new antenna systems and network planning principals.

How 4T4R antennas might impact the radio environment

A1.11 A base station that is using 2T2R antennas that can use two transmit and two receive antennas to transmit and receive signals simultaneously. A 4T4R base station can use four transmit and four receive antennas to transmit and receive signals simultaneously. 4T4R antennas can be used in two different ways to improve capacity and coverage in a cell.

A1.12 The first approach, spatial multiplexing, uses multiple antennas with multiple transmit paths to increase the data rate to a single user (Single User MIMO²⁸) or to multiple users (Multi User MIMO). This is most effective when serving users close to a base station with up to four different transmissions being sent on four uncorrelated paths from the four base station

²⁸ Multiple In Multiple Out

antennas to achieve higher data rates in rich multipath environments with good radio conditions.

- A1.13 The second approach, beamforming, uses multiple antennas to generate a coherent signal of identical transmissions in the direction of a user or users. This is effective when serving users who are far from the base station or indoors, using beamforming to increase the signal strength for those edge of cell users.
- A1.14 Potentially up to twice the amount of power, or 3dB, is being transmitted by a base station using 4T4R antennas when compared with a base station using 2T2R antennas and assuming that each antenna is transmitting the same amount of power. The actual increase of power at a location is dependent on the network traffic management and whether the antenna is in a beamforming or a spatial multiplexing mode.
- A1.15 We expect that the additional power transmitted to a single location will be towards the lower end of the range of 0-3 dB when there are uncorrelated transmissions (spatial multiplexing) and towards the higher end of the range of 0-3 dB when there are correlated transmissions (beamforming).

Future antenna developments beyond 4T4R

- A1.16 In the longer-term antenna systems with a greater number of antennas than 4T4R may be developed for sub-1 GHz bands. We understand that higher order antenna arrays are already used in mid-band, for example, 64T64R antenna systems are commercially available for 3.4 to 3.8 GHz. However, we acknowledge that there are fewer incentives to use high order MIMO systems in lower frequency bands and that there are practical challenges when using very large antenna arrays in lower frequency bands.
- A1.17 5G Americas²⁹ observes that 8T8R passive antenna development is currently focused on mid-band TDD bands to be able to exploit channel reciprocity and beamforming. It also observes that network deployments may follow several strategies but anticipates that all of these will use up to 4T4R antennas only for low frequency FDD bands.³⁰ In 2018, Quintel predicted that 4T4R antenna systems would become important for the 800 MHz band around 2024 and that 8T8R/16T16R antenna systems might become important around 2030.³¹
- A1.18 Lower frequency bands have higher wavelengths which means that the antennas are larger and this means there is a greater engineering challenge deploying massive MIMO at lower frequencies.³² Some of these engineering challenges include practical challenges of deploying

²⁹ §4.1, *Advanced Antenna Systems for 5G*, 5G Americas, August 2019, https://www.5gamericas.org/wp-content/uploads/2019/08/5G-Americas_Advanced-Antenna-Systems-for-5G-White-Paper.pdf, accessed 23 May 2021

³⁰ *ibid.*, §4.4

³¹ Slide 12, *The Future of Base Station antenna in 5G*, [Base Station Antenna needs for the 5G RAN \(slideshare.net\)](https://www.slideshare.net/5G-RAN/Base-Station-Antenna-needs-for-the-5G-RAN)

³² [Massive MIMO: Key to Simplified 5G Networks - Mobile World Live](https://www.mobileworldlive.com/massive-mimo-key-to-simplified-5g-networks/)

the antennas on sometimes already heavily-loaded towers, negotiating rents for the towers, and planning maintenance.³³

- A1.19 Therefore, we think it is unlikely that operators will use 8T8R (or larger) antennas in the short/medium term for the 800 MHz band and the use of 8T8R antenna remains uncertain in the longer term.

Network planning constraints

- A1.20 Modern mobile networks are single frequency networks (SFN) which means that all base stations belonging to an operator are transmitting co-channel with one another. When designing a network an operator needs to consider the balance of a good signal being available from a serving base station and the interfering signals from other nearby base stations. Intercell interference is caused by the simultaneous transmission from multiple base stations to multiple mobile terminals on the same time/frequency resource. To achieve a high data rate a mobile terminal wants a good signal to interference ratio, so a higher intercell interference level will reduce the data rate available. This means that an operator is likely to use lower power levels than the regulatory power limit for many base stations, especially in areas where it has a lot of base stations like urban areas. Additionally, an operator might find that uplink power limits constrain cell size in an area so that additional downlink power would not improve network coverage.³⁴

Summary

- A1.21 Base station transmit power levels are constrained in practice by a number of factors so the regulatory power limit is not always the dominant factor. New antenna systems may be used for spatial multiplexing or beamforming so any increase in power will not be seen everywhere and all the time across the cell.

Compatibility

- A1.22 This section considers the compatibility issues due to both the proposed in-band changes and the out-of-band changes.
- A1.23 In the UK, Ofcom auctioned the 800 MHz band in early 2013. Under a condition in their licences, the 800 MHz licensees were required collectively to set up and operate a scheme to provide advice and assistance to DTT viewers suffering undue interference from mobile services operating in the 800 MHz band and resolve it.
- A1.24 Subsequently, the 700 MHz band was identified for mobile broadband use. In the UK, clearance of the 700 MHz band of its existing DTT users began in late 2017 and concluded earlier this year. It has recently been awarded for mobile broadband use. Under a condition in their licences, the 700 MHz licensees are also required to operate a scheme to provide

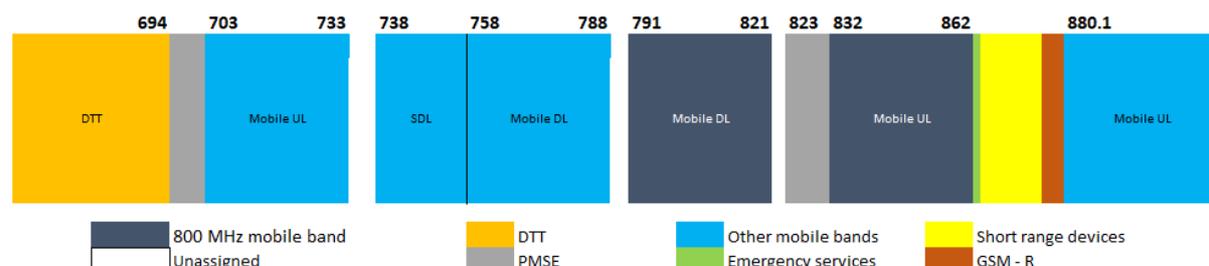
³³ Page 7, [Target Networks in 5G Era 小册子 1130EnV1 \(huawei.com\)](#)

³⁴ Paragraph 7.29a, Award of the 700 MHz and 3.6-3.8 GHz spectrum bands, March 2020, [Statement: Award of the 700 MHz and 3.6-3.8 GHz spectrum bands \(ofcom.org.uk\), accessed 26 May 2021](#)

advice and assistance to DTT viewers suffering undue interference from mobile services and resolve it.

A1.25 Figure A2 shows the 800 MHz mobile band and the adjacent spectrum users. The following paragraphs A1.26 to A1.75, we discuss the compatibility of the licence variation in terms of the proposed in-block changes and the proposed out-of-block changes with the other spectrum users highlighted in this band plan.

Figure A2: The 800 MHz mobile band and adjacent services



Compatibility with mobile services within the 800 MHz band

- A1.26 We consider that the risk of undue interference between licensees in the 800 MHz will not materially change because of the proposed variation.
- A1.27 The European Conference of Postal and Telecommunications Administrations (CEPT) advises on harmonisation of technical licence conditions of mobile use across Europe. CEPT produced CEPT Report 53, which also considered the compatibility of the 700 MHz and 800 MHz band together. It stated³⁵ that, as a consequence of the 700 MHz base station transmit band being adjacent to the 800 MHz base station transmit band (avoiding adjacency between base stations and terminal stations) there is compatibility between the existing 790 to 862 MHz channelling arrangement and the channelling arrangement for the 694 to 790 MHz band.
- A1.28 We are proposing each 800 MHz downlink channel uses the same emission limits below 790 MHz, as 700 MHz DL channel uses toward the 800 MHz mobile DL band. Therefore, we believe that the conclusions from the CEPT Report 53 hold.
- A1.29 We are also proposing to align the emission limits above each 800 MHz downlink channel to the 800 MHz uplink channel with the 800 MHz mask set out in CEPT Report 30. These limits are not included in the Spectrum Access 800 MHz licence . We do not believe the introduction of these limits has any impact on compatibility.

³⁵ Page 10, CEPT Report 53, Report A from CEPT to the European Commission in response to the Mandate “To develop harmonised technical conditions for the 694 -790 MHz ('700 MHz') frequency band in the EU for the provision of wireless broadband and other uses in support of EU spectrum policy objectives” 2014, [CEPTReport053](#)

A1.30 We expect mobile technologies to be resilient to interference from other mobile technologies within the band and that licensees can resolve any coexistence issues between themselves.

Compatibility with services in the adjacent band

Compatibility with Digital Terrestrial Television (DTT)

Summary

- A1.31 This section considers the potential impact of the proposed licence variation on DTT.
- A1.32 Our assessment is that the majority of households would not experience any undue interference due to changes to the base station power limits. After carrying out our assessment we believe that there is a small incremental risk of undue interference to DTT households that would be caused by the proposed changes in power. Even without the proposal to apply the limit on per antenna basis, our assessment is that an increase of 3 dB would be sufficient to cause undue interference in a small number of scenarios.
- A1.33 Homes that have already received filters as a solution for mitigating the impact of interference from 800 MHz mobile networks to DTT households are likely to continue to benefit from good resilience. An increase of power level of base stations may mean that a small number of households that have been remedied may no longer be protected. Operators would still need to take remedial action against any repeat of interference cases, this could mean that they reduce the power of a base station, re-tilt the antenna of a base station, provide a replacement filter, or any other suitable mitigation.
- A1.34 We do not expect that there is an increased risk of undue interference to DTT equipment due to the proposal to modify the out-of-band emissions, as we are proposing to maintain the current emissions limit from the 800 MHz equipment into the DTT band.
- A1.35 We came to these conclusions after reviewing previous analysis and measurements and considering lessons learnt from the original 800 MHz remedial action.
- A1.36 Our analysis is laid out in the following sections:
- Interference mechanisms
 - Previous remedial actions and improvement to DTT receivers
 - Review of measurement campaigns:
 - Likely impact of the proposed licence variation.

Interference mechanisms

- A1.37 Blocking and overloading were found to be the dominant interference mechanisms from the 800 MHz downlink to DTT equipment.^{36,37} Blocking is a reduction in the receiver's sensitivity in the presence of an interfering signal with a frequency offset. Overloading can occur when there is both a high wanted signal and a high interfering signal with a frequency offset to the amplifier or within the passband of the receiver.
- A1.38 CEPT Report 30³⁸ concluded that:
- The impact of interference cannot be arbitrarily reduced through a reduction of the base station out-of-block emission alone due to DTT receiver selectivity. Therefore, other mitigation mechanisms (beyond the emission mask requirements) may be required at a national level to protect DTT.³⁹

Previous remedial action and improvements to DTT receivers

- A1.39 In July 2012 in the Information Memorandum⁴⁰ for the 800 MHz award, we stipulated that: "The 800 MHz Licensees will be required collectively to deliver a single consumer help scheme to households whose primary means of reception of television services is by means of digital terrestrial transmission, and whose reception of such services is disrupted by the transmission of mobile services by the 800 MHz Licensees."
- A1.40 The 800 MHz licences were issued on 1st March 2013 following an auction that started in January 2013. When it was released there was a minimum of a 1 MHz guard band between the 800 MHz downlink and the highest frequency DTT channel.
- A1.41 After the award, Digital Mobile Spectrum Limited (DMSL) was set-up and funded by the 800 MHz licensees. DMSL runs and manages the TV interference mitigation programme, at800.
- A1.42 at800 provides filters for viewers to fit themselves or sometimes arrange for an at800 engineer to visit the property if an interference assessment identifies that mobile signals in 800 MHz are a likely cause of the interference. Approximately 36,000⁴¹ households to date have been remedied. This is less than 0.2% of DTT households in the UK.⁴²
- A1.43 We identified that households that use amplifiers to either boost a signal in areas of poor DTT coverage or distribute a DTT signal round a communal building had a higher risk of

³⁶ Page 4, Assessment of LTE 800 MHz Base Station Interference into DTT Receivers, ERA, July 2011, https://www.ofcom.org.uk/data/assets/pdf_file/0027/33939/ite-800-mhz.pdf

³⁷ Page 3, TV Distribution Amplifier Performance when Interfered with by LTE Base Station and Subsequent Mitigation Filter Testing, ERA, February 2012

³⁸ Page 3, CEPT Report 30: The identification of common and minimal (least restrictive) technical conditions for 790 to 862 MHz for the digital dividend in the European Union, October 2009, [Microsoft Word - CEPTRep030.doc](#)

³⁹ Due to the interference mechanisms being blocking and overloading a likely interference mitigation option at a national level was to use additional filters to protect DTT where it was needed.

⁴⁰ \$5.2, Page 49, https://www.ofcom.org.uk/data/assets/pdf_file/0022/32872/im.pdf

⁴¹ UK Response to ITU-R WP6A RG 1.5 on update of BT.2301

⁴² Page 1, Coexistence of new services in the 700 MHz band with digital terrestrial television: Consultation, May 2017, https://www.ofcom.org.uk/data/assets/pdf_file/0018/101619/Coexistence-of-new-services-in-the-700-MHz-band-with-digital-terrestrial-television.pdf

undue interference.⁴³ Amplifiers have been present in approximately 65%⁴⁴ of households which have reported interference. More interference cases have occurred when there has been a low DTT signal and a high LTE signal.⁴⁵

- A1.44 It has been found⁴⁶ that a bursty signal with a high peak to average ratio can interact with the automatic gain control of some DTT receivers to make them more susceptible to undue interference. Receiver specifications⁴⁷ have been updated (September 2016) to reflect this and so newer DTT receivers should be designed to better able to cope with mobile signals.

Review of measurement campaigns

- A1.45 There have been a large number of measurements taken on DTT equipment investigating the potential impact from LTE.

- A1.46 For our analysis, we have selected three different measurement exercises to assist us with the analysis of the potential impact of this proposed licence variation on DTT use.

- a) In 2012, ERA Technology performed some measurements on two DTT receivers with 6 different amplifiers (3 mast head amplifiers and 3 internal amplifiers) on our behalf.⁴⁸ Amplifiers have been present in approximately 65%⁴⁹ of households which have reported interference.
- b) ECC Report 310⁵⁰, January 2020, has published some more recent measurements on a number of DTT receivers. A total of 12 different DTT receivers (DVB-T2/T receivers) were tested, eight of them being new receivers available on the European market at the time of the development of the report.
- c) In preparation of the 700 MHz award this year, we performed some measurements investigating the DTT reception performance in the presence of 700 and 800 MHz base station signals.⁵¹ The measurements were carried out on three different DTT receivers and 5 different amplifiers (and including no amplifier) to be representative of a number of DTT installations which are vulnerable to interference.

⁴³ Page 3, TV Distribution Amplifier Performance when Interfered with by a LTE Base Station and Subsequent Mitigation Filter Testing, ERA, February 2012, [Microsoft Word - Rep-6919 - 2012-0112 Ofcom](#)

⁴⁴ Page 13, Coexistence of new services in the 700 MHz band with digital terrestrial television, May 2017

https://www.ofcom.org.uk/data/assets/pdf_file/0018/101619/Coexistence-of-new-services-in-the-700-MHz-band-with-digital-terrestrial-television.pdf

⁴⁵ §3.37, page 13, https://www.ofcom.org.uk/data/assets/pdf_file/0018/101619/Coexistence-of-new-services-in-the-700-MHz-band-with-digital-terrestrial-television.pdf

⁴⁶ Page 7, The co-existence of LTE and DTT services at UHF: a field trial, July 2011, [2221/PCFT/R/1.2 \(ofcom.org.uk\)](#)

⁴⁷ Page 22, [EN 303 340 - V1.1.2 - Digital Terrestrial TV Broadcast Receivers; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU \(etsi.org\)](#), September 2016.

⁴⁸ Page 52, Distribution Amplifier Performance when Interfered with by LTE Base Station and Subsequent Mitigation Filter Testing, February 2012, [Microsoft Word - Rep-6919 - 2012-0112 Ofcom](#)

⁴⁹ Page 13, Coexistence of new services in the 700 MHz band with digital terrestrial television, May 2017

https://www.ofcom.org.uk/data/assets/pdf_file/0018/101619/Coexistence-of-new-services-in-the-700-MHz-band-with-digital-terrestrial-television.pdf

⁵⁰ Page 65, ECC Report 310, Evaluation of receiver parameters and the future role of receiver characteristics in spectrum management, including in sharing and compatibility studies, January 2020, [ECC Report 310](#)

⁵¹ Annex 4, https://www.ofcom.org.uk/data/assets/pdf_file/0018/101619/Coexistence-of-new-services-in-the-700-MHz-band-with-digital-terrestrial-television.pdf, May 2017

- A1.47 These measurements showed us although, there is now a greater frequency separation between the 800 MHz band and DTT because of the clearance of 700 MHz for mobile in 2021. We expect that there may be some small coexistence improvements due to frequency separation since we auctioned the 800 MHz band, however we don't think the greater frequency separation alone is sufficient to remove the risk of undue interference.
- Beyond a certain frequency separation between the 800 MHz downlink and DTT equipment, there is limited improvement in resilience to blocking.⁵² Furthermore, the variation in resilience to overload between the different receiver brands is greater than the improvement in overload performance with frequency separation.⁵³
 - The protection ratios of DTT equipment typically improve significantly with up to 20 MHz of frequency separation from the 800 MHz downlink and in some cases very little or gradual improvements in protection ratios beyond 20 MHz frequency separation.⁵⁴ Greater improvements are seen at lower wanted DTT signal strengths because in this case the dominant interference mechanism is blocking rather than receiver overload.
- A1.48 The aggregate interference from both 700 and 800 MHz mobile base stations might risk causing undue interference to some DTT households. There may be a small degradation with 800 and 700 MHz base stations together compared to 800 MHz base stations alone.⁵⁵
- Overall, the baseline measurements on DTT receivers with no amplifier, showed that they are slightly more susceptible to interference (a few dBs) when there is a combined signal of 700 MHz and with a 800 MHz than compared to 800 MHz interference alone when the wanted DTT channel was a high channel. However, the additional impact of the 700 MHz channel was minimal when the wanted DTT channel was a low channel.
 - Our measurements showed that amplifiers and TV receivers are slightly more susceptible (typically 1 to 3 dB in most cases) to combined 800 and 700 MHz interference than to 800 MHz interference alone. In addition, we noted a small effect between the performance on channel 22 and channel 48 with the upper channel being marginally more susceptible, typically by up to 2 dB.

Likely impact of proposed licence variation

- A1.49 We expect that granting the licence variation will mean that there is some additional risk of undue interference and that some DTT households will be impacted due to the change in the allowable in-block power levels of the base stations. We also expect that the aggregate contribution of granting the power increase in 800 MHz and the recent award of 700 MHz for mobile will mean that some additional DTT households are impacted. Noting that we expect

⁵² Distribution Amplifier Performance when Interfered with by LTE Base Station and Subsequent Mitigation Filter Testing, February 2012, [Microsoft Word - Rep-6919 - 2012-0112 Ofcom](#)

⁵³ Page 77, ECC Report 310, Evaluation of receiver parameters and the future role of receiver characteristics in spectrum management, including in sharing and compatibility studies, January 2020, [ECC Report 310](#)

⁵⁴ [2221/PCFT/R/1.2 \(ofcom.org.uk\)](#), [Microsoft Word - Rep-6919 - 2012-0112 Ofcom](#) and [CEPT Report 30](#).

⁵⁵ Page 42, Annex 4, Coexistence of new services in the 700 MHz band with digital terrestrial television: Consultation, May 2017, https://www.ofcom.org.uk/data/assets/pdf_file/0018/101619/Coexistence-of-new-services-in-the-700-MHz-band-with-digital-terrestrial-television.pdf

some of these households will be already at risk of undue interference from mobile deployments in the recently auctioned 700 MHz band.

- A1.50 We do not expect that there is an increased risk of undue interference to DTT due the proposal to modify the emissions between 733 to 790 MHz. We are proposing to maintain the current level of emissions from the 800 MHz band into DTT (the spectrum below 694 MHz). An 800 MHz operator may in the future build a base station that has reduced emissions to protect the 700 MHz mobile uplink (703 to 733 MHz) and thereby in practice the emissions may be reduced within the DTT spectrum. However, the out-of-band emissions are not a dominant interference mechanism, so the impact of this potential reduction of emissions is likely to be minimal.
- A1.51 Modelling the change in the risk of undue interference is difficult because of the very large variability in the quality and performance of individual receive installations which cannot be known in advance.^{56, 57} It is also hard to predict to what extent base station power levels will rise across mobile networks and whether they will be predominantly used in spatial multiplexing or beamforming modes (see paragraphs A1.11 to A1.20 above). Hence, we have not attempted to quantify the risk by modelling, rather we have relied on a qualitative assessment informed by the evidence.
- A1.52 Approximately 36,000⁵⁸ households to date have been remedied for the 800 MHz band in the UK. France awarded 700 MHz for mobile at the end of 2015 and reported in March 2021 that fewer DTT households have needed to be remedied compared to when the 800 MHz band was awarded for mobile.⁵⁹
- A1.53 Homes that have already received filters as a solution for mitigating the impact of undue interference from 800 MHz mobile networks to DTT reception are likely to continue to benefit from good resilience. However, an increase of base station power level may mean that a small number of households that have been remedied may no longer be protected. Operators would still need to take remedial action against any repeat of undue interference cases, this could mean that they reduce the power of a base station, re-tilt the antenna of a base station, or provide a replacement filter.

⁵⁶ Page 13, Coexistence of new services in the 700 MHz band with digital terrestrial television: Consultation, May 2017, https://www.ofcom.org.uk/_data/assets/pdf_file/0018/101619/Coexistence-of-new-services-in-the-700-MHz-band-with-digital-terrestrial-television.pdf

⁵⁷ Coexistence between LTE and DTT - Practical experience following the clearance and relicensing of 800 MHz spectrum in the UK, [Coexistence between LTE and DTT: Practical experience following the clearance and relicensing of 800 MHz spectrum in the UK - BBC R&D](#)

⁵⁸ UK Response to ITU-R WP6A RG 1.5 on update of BT.2301, Document 6A/TEMP/114-E, [PRELIMINARY] DRAFT REVISION OF REPORT ITU-R BT.2301, National field reports on the introduction of IMT in the bands with co-primary allocation to the broadcasting and the mobile services, March 2021, <https://www.itu.int/md/R19-SG06-C-0121/en>

⁵⁹ French Response to ITU-R WP6A RG 1.5 on update of BT.2301, Document 6A/TEMP/114-E, [PRELIMINARY] DRAFT REVISION OF REPORT ITU-R BT.2301, National field reports on the introduction of IMT in the bands with co-primary allocation to the broadcasting and the mobile services, March 2021, <https://www.itu.int/md/R19-SG06-C-0121/en>

Compatibility with 700 MHz and 900 MHz mobile

- A1.54 We expect mobile technologies to be resilient to undue interference from mobile technologies in adjacent bands.
- A1.55 CEPT advised on harmonisation of technical licence conditions of mobile use across Europe. CEPT produced CEPT Report 53, which also considered the compatibility of the 700 MHz and 800 MHz band together. It stated that, as a consequence of the 700 MHz base station transmit band being adjacent to the 800 MHz base station transmit band (avoiding adjacency between base stations and terminal stations) there is compatibility between the existing 790 to 862 MHz channelling arrangement and the channelling arrangement for the 694 to 790 MHz band.⁶⁰
- A1.56 The in-block power limit will be identical between 700 MHz and 800 MHz as a result of the proposed change. The in-block power limit for 900 MHz will be slightly different, but not significantly different.
- A1.57 As part of this licence variation we propose that the out-of-band emissions from the 800 MHz downlink band to the 700 MHz downlink band is identical to the out-of-band emissions from the 700 MHz downlink to the 800 MHz downlink band. We consider that the conclusions of the CEPT Report 53 still hold true with this scenario.
- A1.58 We are not proposing to make the out of band emissions in the 700 MHz mobile uplink band (703 MHz to 733 MHz) more restrictive, even though the 700 MHz licences have an emission level ~50dB lower to protect their mobile uplink from their mobile downlink. CEPT have already concluded the channelling arrangements are compatible we do not believe that maintaining the current limits would result in undue interference. If there were any concerns raised about the 800 MHz out-of-band limits we would have expected these to have been found as part of CEPT and Ofcom's technical analysis when preparing for the allocation of 700 MHz for mobile services.
- A1.59 We expect all of these bands (700, 800 and 900 MHz) to be used in a similar way to provide mobile services so we consider that there are likely to be mutual incentives to resolve any compatibility issues between licensees. We consider that this is likely to not be overly burdensome on licensees because there are a small number of licensees holding 700, 800 and 900 MHz mobile licences. Therefore, we consider that the proposed increase in the power limit for 800 MHz mobile is unlikely to result in undue interference to 700 and 900 MHz licensees.

⁶⁰ Page 10, CEPT Report 53, Report A from CEPT to the European Commission in response to the Mandate "To develop harmonised technical conditions for the 694 -790 MHz ('700 MHz') frequency band in the EU for the provision of wireless broadband and other uses in support of EU spectrum policy objectives" 2014, [CEPT Report 53](#)

Compatibility with Short Range Devices (SRDs)

- A1.60 In the UK, we use 862 to 876 MHz for short range devices⁶¹. SRDs are allowed to operate at particular radio frequencies without the need for a licence unlike many other kinds of wireless equipment which are licensed to use radio spectrum. Licence-exempt operation for SRDs is permitted on the basis that devices do not cause interference to other users and that they can expect no protection from interference caused by properly licensed users operating in nearby frequencies.
- A1.61 In preparation of the 800 MHz award we published an update document⁶² and we highlighted that even though SRDs, including social alarms, operate without any expectation of protection against interference, we wanted to find out whether LTE devices would cause problems for users. We wanted to make sure that manufacturers and users had as much information as possible in case they needed to adapt their devices or how they were operated. We stated that the potential for interference to SRDs stems from the 800 MHz mobile device uplink transmissions in 832 to 862 MHz, which is closer in frequency to the SRD band than the 800 MHz mobile base station downlink transmission band in 791 to 821 MHz. We also stated that although the power levels transmitted by network base stations themselves are likely to exceed by a great deal those transmitted by consumer devices, the frequencies they use to downlink data to consumers (791 to 821 MHz) are sufficiently far away from the SRD band to present little or no risk of interference.
- A1.62 ECC Report 207⁶³ investigated the potential risk of interference from mobile devices in the 800 MHz band into SRDs. It did not consider LTE base stations a significant risk and so they were out of the scope of the report.
- A1.63 In our Information Update prior to the 800 MHz award, we concluded that the likelihood and extent of interference from LTE will be low and the imposition of additional licence conditions on users of 800 MHz spectrum was not justified.⁶⁴
- A1.64 We have additionally sought out information on interferences cases for this SRD band over the last 4 years (2017 to 2021). There were less than 20 interference cases to SRDs reported for the band, and very few of these could be linked or potentially linked to interference caused by mobile services.
- A1.65 Across Europe, the SRD band is situated between two high power mobile bands, the 800 MHz and 900 MHz bands. The European Commission Decisions for each band do not require an in-band base station limit but advise on a value that might be used. We are aware that several other administrations do not have an in-band power limit for base stations in the

⁶¹ IR 2030 – UK Interface Requirements 2030 Licence Exempt Short Range Devices, [IR 2030 – Licence Exempt Short Range Devices \(ofcom.org.uk\)](#), April 2021

⁶² Page 5, Use of Short Range Devices alongside mobile broadband services operating in the 800MHz band, November 2011, [RE: SRDs Statement \(ofcom.org.uk\)](#)

⁶³ ECC Report 207 Adjacent band coexistence of SRDs in the band 863-870 MHz in light of the LTE usage below 862 MHz, January 2014, [ECO Documentation \(cept.org\)](#)

⁶⁴ Page 5, Use of Short Range Devices alongside mobile broadband services operating in the 800MHz band, November 2011, [RE: SRDs Statement \(ofcom.org.uk\)](#)

licences issued to the mobile operators using the 800 MHz and the 900 MHz band.⁶⁵ The SRDs currently need to coexist between these high power bands where in some countries they have no in-band power limit for base stations. Therefore, we consider that the increase in the power limit for 800 MHz mobile base stations is unlikely to result in undue interference to SRDs in the 862 to 876 MHz band.

- A1.66 This licence variation proposal does not change the out-of-band emission limits that fall within the SRD band.
- A1.67 Therefore, we do not consider that this licence variation proposal will be likely to result in undue interference to SRDs in the 862 to 876 MHz band.

Compatibility with Emergency Services

- A1.68 Emergency Services have been allocated 862 to 863 MHz. We are not proposing to change the out-of-band emissions from the 800 MHz base stations within the spectrum used by Emergency Services. Following discussions with the emergency services, we have assured ourselves the increase in the power limit of 800 MHz mobile base stations is unlikely to result in undue interference to services using that band.

Compatibility with Programme Making and Special Events (PMSE)

- A1.69 PMSE have been allocated 694 to 703 MHz and 823 to 832 MHz. This is predominantly used for radio microphones. We are not proposing to change the out-of-band emission limits within 694 to 703 MHz due to this proposed licence variation. We plan to introduce band emission limits between 821 to 832 MHz. We would not expect this licence variation proposal to change the risk of undue interference to PMSE.

Compatibility with Global System for Mobile Communications-Railway (GSM-R)

- A1.70 The 876 to 880 MHz band is used for GSM-R. GSM-R⁶⁶ provides communications between train drivers and signallers. The band 874.4 to 876 MHz has been highlighted in a European Commission Decision^{Error! Bookmark not defined.} as needing further study as a possible band for Future Railway Mobile Communication System (FRMCS).
- A1.71 We are not proposing to change the out-of-band emissions from the 800 MHz base stations within the spectrum used by GSM-R or the 874.4 to 876 MHz band which has been highlighted for possible future use of FRMCS.
- A1.72 There is currently a co-ordination procedure⁶⁷ to co-ordinate GSM-R use and licensees in the first adjacent 10 MHz of the 900 MHz band, but there is no co-ordination requirement for other 900 MHz licensees. The 900 MHz licences allow for a base station in-block downlink

⁶⁵ Page 20, Variation of 900 MHz, 1800 MHz and 2100 MHz Mobile Licences, February 2013, [condoc.pdf \(ofcom.org.uk\)](#)

⁶⁶ [GSM-R: the railway's mobile communication system - Network Rail](#)

⁶⁷ Notice of Co-ordination Procedure required for 3G or 4G deployment under the Public Wireless Network Licences covering the 900 MHz band, July 2013, [Statement \(ofcom.org.uk\)](#)

power of up to 65 dBm/(5 MHz) EIRP⁶⁸ which is similar to what we are proposing to allow for the 800 MHz band.

- A1.73 We would not expect this licence variation proposal to change the risk of undue interference to the GSM-R band, or FRMCS in the 874.4 to 876 MHz band.

Compatibility with potential future users of unassigned bands

- A1.74 The bands 733 to 738 MHz between 700 MHz Mobile UL and SDL and 788 to 791 MHz between 700 MHz and 800 MHz Mobile DL are not currently used but may be used in the future. CEPT Report 53 proposes two options for these bands: PPDR and M2M communications.
- A1.75 The protection level we propose for these bands mirrors what we offer from the 700 MHz band. Therefore, both the 700 MHz and the 800 MHz emissions into the band will be similar. This would give any potential future use slightly less protection than it would have currently, but it does not significantly alter the current potential utility of the band due to the existing emission limits from the 700 MHz band.

⁶⁸ <https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/mobile-wireless-broadband/below-5ghz>

A2. Proposed changes to Spectrum Access 800 MHz licence document

Proposed changes are marked in **bold text and yellow highlight** for additions and ~~strikethrough~~ for text we're proposing to remove.

SCHEDULE 1 TO LICENCE NUMBER: ~~xxxxxxx~~

Schedule Date: ~~xx xxxx 2021~~

Licence category: ~~Spectrum Access Licence (790 – 862 MHz)~~

Description of Radio Equipment

1. References in this schedule to the Radio Equipment are references to any wireless telegraphy station or wireless telegraphy apparatus that is established, installed and/or used under this schedule.

Interface Requirements for the Radio Equipment

2. Use of the Radio Equipment shall be in accordance with the following Interface Requirement:

IR 2090: Terrestrial systems capable of providing electronic communications services in the 800 MHz band

Special conditions relating to the Radio Equipment

3.
 - (a) Subject to paragraph 3(b) of this schedule, during the period that this Licence remains in force, unless consent has otherwise been given by Ofcom, the Licensee shall compile and maintain accurate written records of the following details relating to the Radio Equipment:
 - i) postal address (including post code);
 - ii) National Grid Reference, to at least 1 metre resolution;
 - iii) antenna height (above ground level), type, and boresight bearing east of true north (if applicable); and
 - iv) radio frequencies which the Radio Equipment uses

and the Licensee must produce these records if requested by any person authorised by Ofcom.

- (b) The conditions relating to the keeping of records contained in sub-paragraphs 3(a)(ii) and (iii) of this schedule shall not apply in respect of femtocell equipment and smart/intelligent low power repeater equipment.

- (c) The Licensee shall submit to Ofcom copies of the records detailed in sub-paragraph 3(a) above at such intervals as Ofcom may notify to the Licensee.
- (d) The Licensee shall provide to:
 - i) Ofcom;
 - ii) the entity established in accordance with paragraphs 2.1 – 2.2 of the “*Notice of DTT interference mitigation procedures required under spectrum access licences for the 800 MHz band*” notified to it by Ofcom in accordance with paragraph 4 of this schedule; and/or
 - iii) the Oversight Board

in such manner and at such times as they may reasonably require, such documents or other information as they may require for the purposes of taking steps to mitigate interference to users of the electromagnetic spectrum in the 470-790 MHz band, or to make recommendations to Ofcom or Government with respect to such steps being taken.

Co-ordination at frequency and geographical boundaries and compliance with other procedures relating to interference

- 4. The Licensee shall ensure that the Radio Equipment is operated in compliance with such co-ordination procedures as may be notified to the Licensee by Ofcom from time to time. The Licensee shall also ensure that it complies with any other procedures relating to the mitigation of interference as may be notified to the Licensee by Ofcom from time to time.

International cross-border co-ordination

- 5. The Licensee shall ensure that the Radio Equipment is operated in compliance with such cross-border co-ordination and sharing procedures as may be notified to the Licensee by Ofcom from time to time.

Permitted Frequency Blocks

- 6. Subject to the emissions permitted under paragraph 10 of this schedule, the Radio Equipment may only transmit within the following frequency bands (the “Permitted Frequency Blocks”):

Downlink frequencies	Uplink frequencies
xxx – xxx MHz	xxx – xxx MHz

Maximum power within the Permitted Frequency Blocks

- 7. The power transmitted in the Permitted Frequency Blocks shall not exceed:
 - (a) Downlink Frequencies

	Maximum mean power dBm / (5 MHz) EIRP per antenna
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Radio Equipment*	64 61
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* For femtocell base stations, power control must be applied to minimise interference to adjacent channels.

The maximum EIRP relates to the EIRP of a specific piece of Radio Equipment irrespective of the number of transmit antennas

(b) Uplink Frequencies⁶⁹

Radio Equipment	Maximum mean power
Fixed or installed Radio Equipment	23dBm EIRP*
Mobile or nomadic Radio Equipment	23dBm TRP*

* The maximum mean power relates to the EIRP or TRP of a specific piece of Radio Equipment irrespective of the number of transmit antennas.

Maximum power of base stations outside the Permitted Frequency Blocks

8. For transmissions on the downlink frequencies, the EIRP emanating from the Radio Equipment transmissions at any frequency outside the downlink frequencies of the Permitted Frequency Blocks, shall not exceed the higher (least stringent) of (a) the baseline requirements and (b) the transition requirements for that frequency **but within 791 – 821 MHz, shall not exceed:**

Frequency range	Maximum mean EIRP per antenna	Measurement bandwidth
-5 to 0 MHz offset from lower block edge 0 to 5 MHz offset from upper block edge	22 dBm	5 MHz
-10 to -5 MHz offset from lower block edge 5 to 10 MHz offset from upper block edge	18 dBm	5 MHz
Out of block baseline power limit (BS) < -10 MHz offset from lower block edge > 10 MHz offset from upper block edge	11 dBm	1 MHz

9. In addition, the EIRP emanating from the Radio Equipment transmissions at any frequency outside the downlink frequencies of the Permitted Frequency Blocks shall not exceed the higher (least stringent) of (a) the baseline requirements and (b) the transitional requirements for that frequency

(a) Baseline requirements

⁶⁹ Consumer user equipment will be authorised by means of a licence exemption under section 8 of the Wireless Telegraphy Act 2006

Frequency range	In-block EIRP, P, dBm/(10 MHz)**	Maximum mean EIRP in frequency range	Measurement bandwidth
470 to 733 MHz 790 MHz	$P \geq 59$	0 dBm*	8 MHz
	$36 \leq P < 59$	(P-59) dBm*	8 MHz
	$P < 36$	-23 dBm*	8 MHz

* The maximum EIRP relates to the EIRP of a specific piece of Radio Equipment irrespective of the number of transmit antennas.

** This is the in-block EIRP measured in a bandwidth of 10MHz.

Frequency range	Maximum mean EIRP	Measurement bandwidth
733 to 788 MHz	16 dBm per antenna	5 MHz
788 to 790 MHz	12 dBm per antenna	2 MHz
790 to 791 MHz	17.4 dBm per antenna	1 MHz
821 to 832 MHz	15 dBm per antenna	1 MHz
832 to 862 MHz	-49.5 dBm*	5 MHz

* The maximum EIRP relates to the EIRP of a specific piece of Radio Equipment irrespective of the number of transmit antennas.

(b) Transitional requirements

For a block with a lower edge of 791 MHz

Frequency range	Maximum mean EIRP per antenna	Measurement bandwidth
778 – 783 MHz	17 dBm	5 MHz
783 – 788 MHz	19 dBm	5 MHz
788 – 791 MHz	21 dBm	3 MHz

For a block with a lower edge of 796 MHz

Frequency range	Maximum mean EIRP per antenna	Measurement bandwidth
783 – 788 MHz	17 dBm	5 MHz
788 – 791 MHz	16 dBm	3 MHz

Interpretation of terms in this schedule

10. In this schedule:

- (a) “dBm” means the power level in decibels (logarithmic scale) referenced against 1milliwatt (i.e. a value of 0 dBm is 1 milliwatt);
- (b) “EIRP” means the equivalent isotropically radiated power. This is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain);
- (c) “femtocell” means Radio Equipment transmitting on the downlink frequencies, which operates at a power not exceeding 24 dBm EIRP per carrier, and which is or will be used only by and under the control of the Licensee, following the establishment of a telecommunications link between the femtocell and a network of the Licensee;
- (d) “Fixed or installed” means used or installed at specific fixed points;
- (e) “IR” means a United Kingdom Radio Interface Requirement published by Ofcom in accordance with Article 4.1 of Directive 1995/5/EC of the European Parliament and of the Council on radio equipment and telecommunications terminal equipment (RTTE) and the mutual recognition of their conformity;
- (f) “lower block edge” means, in relation to each Permitted Frequency Block, the lowest frequency in that Permitted Frequency Block;
- (g) “measurement bandwidth” means the size of an individual spectrum segment within the specified frequency range that is used to measure compliance with the specified power limit;
- (h) “mobile or nomadic” means intended to be used while in motion or during halts at unspecified points;
- (i) “Oversight Board” has the meaning given to it in the “Notice of DTT interference mitigation procedures required under spectrum access licences for the 800 MHz band” notified to the Licensee under paragraph 4 of this schedule;
- (j) “Permitted Frequency Blocks” has the meaning given to it in paragraph 8 of this schedule;
- (k) “smart/intelligent low power repeater” means a repeater which operates with power not exceeding 24 dBm EIRP per carrier, which may be established by customers of the Licensee who have written agreements with the Licensee and:
 - The Licensee has ultimate control of the repeater, i.e. each individual repeater can be disabled remotely by the Licensee;
 - The repeater operates only on the Licensee’s frequencies and with their valid Public Land Mobile Network Identifier;
 - Must not cause undue interference to other spectrum users; and

- The repeater only transmits on the uplink frequencies when actively carrying a call (voice, video or data) or signalling from serviced handsets;
- (l) “TRP” means the total radiated power. This is the integral of the power transmitted in different directions over the entire radiation sphere;
- (m) “upper block edge” means, in relation to each Permitted Frequency Block, the highest frequency in that Permitted Frequency Block.

Ofcom

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 7 September 2021.
- A3.2 You can download a response form from <https://www.ofcom.org.uk/consultations-and-statements/category-2/technical-conditions-of-mobile-licences-in-800-mhz>. 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 Ruth.John@ofcom.org.uk, as an attachment in Microsoft Word format, together with the [cover sheet](#).
- A3.4 We welcome responses in formats other than print, for example an audio recording or a British Sign Language video. To respond in BSL:
- 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
 - Upload a video of you signing your response directly to YouTube (or another hosting site) and send us the link.
- A3.5 We will publish a transcript of any audio or video responses we receive (unless your response is confidential)
- A3.6 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.
- A3.7 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.
- A3.8 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 6. 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.
- A3.9 If you want to discuss the issues and questions raised in this consultation, please contact Paul Chapman by email to Paul.Chapman@Ofcom.org.uk.

Confidentiality

- A3.10 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.

- A3.11 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.
- A3.12 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.
- A3.13 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

- A3.14 Following this consultation period, Ofcom plans to publish a statement by November 2021.
- A3.15 If you wish, you can [register to receive mail updates](#) alerting you to new Ofcom publications.

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

A6.1 Ofcom invites third parties to respond to the questions set out below. Please provide Ofcom with available supporting evidence where possible.

Question 1: Do you agree with our proposals to change the in-band power limits contained in the Spectrum Access 800 MHz licence and Ofcom's assessment of the risk of interference? If you disagree, please provide details.

Question 2: Do you agree with our proposals to require licensees to have in place a mitigation scheme to resolve any DTT issues should they occur? If not, please provide details.

Question 3: Do you agree with the proposals to relax the out-of-band emission limits? If you disagree, please provide details.

Question 4: Do you agree with the proposals to reintroduce the transitional out-of-band and out-of-block emission limits? If you disagree, please provide details.

Question 5: Do you have any further comments on the technical assessment carried out by Ofcom in Annex 1 of this document

Question 6: Do you agree with Ofcom's assessment on whether to change the emissions limits of the Spectrum Access 800 MHz licences? If you disagree, please provide further information.

A7. Legal framework

- A7.1 This section provides an overview of the main legislative provisions relevant to wireless telegraphy licensing and the proposed variations. It is not a full statement of all the legal provisions which may be relevant to Ofcom's functions and to wireless telegraphy licensing.
- A7.2 The applicable legal framework derives from our duties and powers under both the Communications Act 2003 (the 2003 Act) and the Wireless Telegraphy Act 2006 (the 2006 Act).

Licence variation

Ofcom's powers to vary a spectrum licence

- A7.3 Our powers to carry out our spectrum functions are set out in the 2006 Act. Such powers include, under sections 9 and 10, the general power to revoke or vary any wireless telegraphy licences. Schedule 1 of the 2006 Act sets out a process for the variation of wireless telegraphy licences.
- A7.4 We have a duty set out in section 9(7) of the 2006 Act to ensure that wireless telegraphy licence conditions are objectively justified in relation to networks and services to which they relate, non-discriminatory, proportionate and transparent. We consider that this obligation is ongoing and must be assessed against market circumstances and the state of technology development at the time.
- A7.5 We have a broad discretion under paragraph 6 of Schedule 1 of the 2006 Act to vary licences, subject to certain limitations:
- pursuant to paragraph 6A of Schedule 1 of the 2006 Act, any variation of a wireless telegraphy licence must be objectively justifiable;
 - UK obligations under international agreements where use of spectrum has been harmonised: we will not agree to remove restrictions from licences or other changes that would conflict with the UK's obligations under international law;
 - section 5 of the 2003 Act and section 5 of the 2006 Act enable the Secretary of State to give us directions in respect of the carrying out of our spectrum functions;
 - we must act in accordance with our statutory duties, including our duty to secure optimal use of the spectrum and our duties under section 3 of the 2006 Act; and
 - general legal principles, which include the duties to act reasonably and rationally when making decisions and to take account of any legitimate expectations.

The licence variation process

- A7.6 Paragraph 7 of Schedule 1 of the 2006 Act sets out a process for the variation of wireless telegraphy licences.
- A7.7 Where we propose to vary a wireless telegraphy licence, we must:

- give the licensee a notice which sets out the reasons for the proposed variation and specifies the period within which the licensee may make representations about the proposal.

A7.8 We must then within 1 month of the end of that period:

- decide whether or not to vary the licence in accordance with our proposal or with modifications; and
- notify the licensee of our decision and the reasons for it.

A7.9 However, this process does not apply to a proposed licence variation that is made at the request or with the consent of the licensee.

Ofcom's duties when carrying out spectrum functions

A7.10 In carrying out our spectrum functions we have a duty under section 3 of the 2006 Act to have regard, in particular, to:

- the extent to which the spectrum is available for use, or further use, for wireless telegraphy;
- the demand for use of that spectrum for wireless telegraphy; and
- the demand that is likely to arise in future for such use.

A7.11 We also have a duty to have regard, in particular, to the desirability of promoting:

- the efficient management and use of the spectrum for wireless telegraphy;
- the economic and other benefits that may arise from the use of wireless telegraphy;
- the development of innovative services; and
- competition in the provision of electronic communications services.

Ofcom's general duties

A7.12 Our principal duty under section 3(1) of the 2003 Act, when carrying out our functions, is:

- to further the interests of citizens in relation to communications matters; and
- to further the interests of consumers in relevant markets, where appropriate by promoting competition.

A7.13 In doing so, we are also required by section 3(2) to secure (among other things):

- the optimal use of spectrum, and
- the availability throughout the United Kingdom of a wide range of electronic communications services.

A7.14 Section 3(4) also requires us to have regard to the following matters (amongst others):

- the desirability of promoting competition in relevant markets;
- the desirability of encouraging investment and innovation in relevant markets;
- 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

- 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.

A7.15 Section 4 of the 2003 Act requires us, when carrying out our spectrum management functions, to act in accordance with additional requirements, including:

- the requirement to promote competition; and
- the requirement to promote the interests of all members of the public in the UK.

A7.16 Where it appears to us that any of our duties in section 3 of the 2006 Act conflict with one or more of our general duties under sections 3 to 6 of the 2003 Act, we must give priority to our duties under the 2003 Act.