Enabling future use of the unpaired 2100 MHz (1899.9–1920 MHz) spectrum

Statement

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Annexe

1. Overview

1.1 Ofcom is responsible for managing the UK's radio spectrum, ensuring it is used in the best interests of all in the UK. It is the finite resource crucial to delivering a wide range of valuable wireless applications benefitting many different users.

1.2 In this Statement, we set out our decision to start the statutory process to revoke the unpaired 2100 MHz spectrum licences.

What we have decided – in brief

We want to secure optimal use of the unpaired 2100 MHz spectrum and to do so in an efficient and timely manner to enable citizens and consumers to benefit from new services. Having considered responses to our proposal to revoke the licences, we confirm our view that:

a) The current non-use of the unpaired 2100 MHz spectrum, with no realistic prospect of it being used in the future for high power public mobile services (as was originally intended when allocated), is not optimal.

b) Planned use of the 1900–1910 MHz spectrum by EE for the ESN Gateway on its own is not optimal because there is a higher value use of the spectrum.

c) Alternative use of 1910–1920 MHz spectrum (once established) will be more optimal than the existing non-use.

d) There are potential complexities to achieving optimal use through trading in this band (where applicable) such that we cannot rely on it to achieve our policy objective.

e) Regulatory intervention through licence revocation is appropriate and proportionate to secure optimal use of the unpaired 2100 MHz spectrum and more likely than not to achieve this in a timely manner compared to relying on trading and liberalisation.

We have therefore decided to:

- Start the statutory process to revoke all of the unpaired 2100 MHz spectrum licences with a five-year notice period.
- Not to set annual licence fees for these licences during the revocation period.

We note that the decisions set out in this document are subject to the outcome of the statutory process for revoking the unpaired 2100 MHz spectrum licences.

We will consult in due course on the future allocation of the unpaired 2100 MHz spectrum and if necessary, on alternative spectrum for the ESN Gateway.

2. Introduction

Background

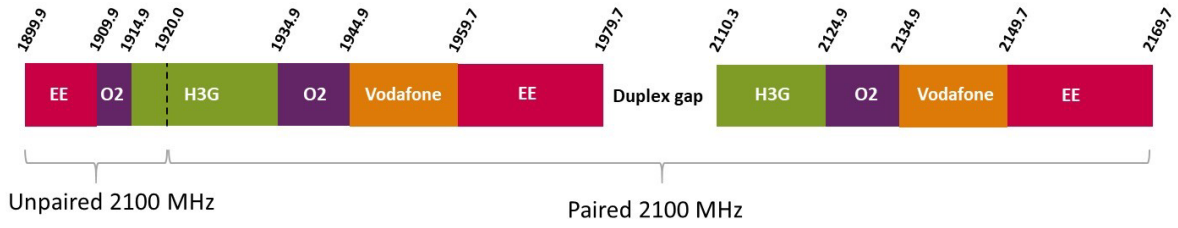
Licence history

2.1 The unpaired 2100 MHz spectrum[1] is licensed to three of the four current mobile network operators (MNOs): Everything Everywhere (EE)[2], H3G and Virgin Media O2 (VMO2)[3]. The spectrum holdings are shown in Table 1 and Figure 1 below.

Table 1: Spectrum holdings in the 2100 MHz spectrum

2100 MHz band	EE	H3G	VMO2	Vodafone
Paired spectrum	40 MHz	29.5 MHz	20 MHz	29.6 MHz
Unpaired spectrum	10 MHz	5.1 MHz	5 MHz	-

Figure 1: Spectrum holdings in the 2100 MHz spectrum



2.2 Originally auctioned together with the paired 2100 MHz spectrum[4] for the deployment of third generation (3G) national mobile networks in April 2000, the licences for the unpaired spectrum were initially granted for a fixed period of 20 years.

2.3 In June 2011, Ofcom varied[5] each of the 2100 MHz licences in order to give effect to a Government Direction (the Direction).[6] Amongst other things, each of the licences was made indefinite (subject to revocation by Ofcom or surrender by the licensee) and included a new provision requiring the payment of annual licence fees (ALF) from 1 January 2022.

2.4 In 2013 we consulted on, and subsequently granted, variation requests from mobile operators to liberalise their spectrum licences in several mobile bands, including the 3G licences for the 2100 MHz spectrum. We removed the restriction on using 3G (UMTS) technology and allowed the use of 4G technologies including WiMAX and LTE.[7] However, the

[1] 1899.9–1920 MHz.
[2] Acquired by BT in 2016.
[3] Virgin Media merged with O2 in June 2021 and are now known as Virgin Media O2 (VMO2).
[4] 1920–1979.7 MHz paired with 2110.3–2169.7 MHz.
[5] Ofcom, Statement on variation of 2100 MHz Third Generation Mobile Wireless Telegraphy Act Licences, June 2011.
[6] The Wireless Telegraphy Act 2006 (Directions to OFCOM) Order 2010.
[7] Long Term Evolution (LTE) is a 4G mobile technology. Worldwide Interoperability for Microwave Access (WiMAX) is a wireless technology, similar to WiFi, but with a longer range which can cover many kilometres.

liberalisation of these licences did not include the 2100 MHz unpaired (TDD[8]) frequencies at that time. This was because the unpaired frequency ranges included in the 2100 MHz licences were the subject of ongoing regulatory work in Europe to examine potential future uses and the technical conditions that might be required to enable such uses.[9]

2.5 In the absence of concrete plans to deploy services using the unpaired spectrum in these licences, we did not consider it sensible to vary the technical conditions for UK operators at that time. The 2100 MHz unpaired spectrum therefore remained for 3G only and was placed into a separate licence schedule (Schedule 2) of the 2100 MHz licences.[10]

2.6 We noted at the time, that an output of the work in Europe was a recommended set of technical conditions that would be appropriate for 4G use of these TDD frequencies. It recommended significantly lower power limits than in the current licences (with these power limits being different depending on where the frequency block is within the frequency range) in order to protect adjacent FDD use of the 2100 MHz band. In light of this we said at the time that if any of the operators made a formal application to vary their licences, the sole effect of which would be to reflect these technical conditions for 4G use of their TDD blocks, then we would consult on a proposal to make the appropriate licence variations.[11]

2.7 In 2017, following such an application by EE to vary it's licence, Ofcom consulted and decided to vary the terms of EE's licence to support the provision of a gateway for extended coverage of the new Emergency Services Network (ESN), using 4G (TD-LTE[12]) in the unpaired frequencies 1899.9 to 1909 MHz.[13] We did this by adding a schedule to EE's 2100 MHz licence (Schedule 3) which enables LTE at the specified power level,[14] with additional conditions specifically for the ESN network. We did not receive requests for the other two 2100 MHz unpaired TDD spectrum licences to be amended for 4G use. As a result of this EE is currently authorised to use both 3G and 4G while VMO2 and H3G can only use 3G in their respective 2100 MHz unpaired frequencies.

Annual licence fee consultation for the 2100 MHz spectrum

2.8 In July 2021 Ofcom published a consultation seeking views on the proposed level of annual licence fees that should apply to the 2100 MHz spectrum, including the unpaired spectrum (the July 2021 consultation).

2.9 Based on the responses we received, which indicated there were no plans by the current licensees to deploy high-power mobile services in the unpaired spectrum, we stated our

[8] TDD (also known as TD or Time-Division Duplexing) is used in networks where the downlink and uplink frequencies used to transmit are the same (i.e. unpaired spectrum), but the time slots for each are different.
[9] Ofcom, Statement on the Requests for Variation of 900 MHz, 1800 MHz and 2100 MHz Mobile Licences, paragraph 3.8, July 2013.
[10] Terms of the 2100 MHz licences can be found on Ofcom's website.
[11] Ofcom, Statement on the Requests for Variation of 900 MHz, 1800 MHz and 2100 MHz Mobile Licences, paragraph 3.8.
[12] TD-LTE means the TDD (time division) variant of LTE. TD-LTE uses unpaired spectrum.
[13] Ofcom, EE application for licence variations in support of enhanced mobile communications for the emergency services, January 2017.
[14] The licence permits 43 dBm EIRP in 1899.9–1904.9 MHz and 30 dBm in 1904.9–1909.9 MHz EIRP.

concern in our Statement on Annual Licence fees for 2100 MHz Spectrum[15] that the unpaired 2100 MHz spectrum would continue to be unused by the current licensees.

2.10 We explained that we would consider how we might enable this spectrum to be used more effectively in the future noting potential demand for other services and decided not to set an annual licence fee for the unpaired 2100 MHz spectrum at that time.

Future use of the unpaired 2100 MHz spectrum

2.11 In March 2023[16] we consulted on how we might enable this spectrum to be used more effectively in the future. We identified potential emergency services gateway use, European harmonisation for railway services and other potential demands, including the utilities sector spectrum requirement for a secure network, and included a proposal to revoke the unpaired licences. We received 16 responses – the non-confidential versions of these responses can be found on the Ofcom website.

2.12 This Statement sets out our decision to start the statutory process to revoke all the unpaired 2100 MHz spectrum licences in order to secure optimal use of the unpaired 2100 MHz spectrum in an efficient and timely manner.

Relevant legal framework

2.13 Ofcom has a number of duties under the Communications Act 2003 (the "Communications Act") and the Wireless Telegraphy Act 2006 (the "Wireless Telegraphy Act"), which are relevant to its spectrum management functions.

2.14 The Communications Act sets out Ofcom's general duties, including its 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[17]. By virtue of these duties, Ofcom is required to secure, among other things, the optimal use for wireless telegraphy of the electro-magnetic spectrum and the availability of a wide range of electronic communications services throughout the United Kingdom.[18]

2.15 In performing its duties, Ofcom also has to have regard to a number of factors as it appears relevant in the circumstances, including the desirability of promoting competition and encouraging investment and innovation in relevant markets and the interests of everyone who may wish to use the spectrum for wireless telegraphy.[19]

2.16 The Communications Act further provides that, in performing its duties, Ofcom must in all cases have regard to the principles of transparency, accountability, proportionality, and consistency, as well as ensuring that its actions are targeted only at cases in which action is needed.[20]

[15] Ofcom, Annual licence fees for 2100 MHz spectrum, December 2021.
[16] Exploring future use of the unpaired 2100 MHz (1900 - 1920 MHz) spectrum, March 2023.
[17] Please refer to section 3(1) of the Communications Act.
[18] Please refer to section 3(2) of the Communications Act.
[19] Please refer to section 3(4) of the Communications Act.
[20] Please refer to section 3(3) of the Communications Act.

2.17 The Wireless Telegraphy Act also imposes a number of further duties relating to spectrum management. These duties include having regard to:

a) the extent to which the electromagnetic spectrum is available for use, or further use, for wireless telegraphy;

b) the demand for use of the spectrum for wireless telegraphy;

c) the demand that is likely to arise in future for the use of the spectrum for wireless telegraphy; and

d) the desirability of promoting:

i) the efficient management and use of the part of the electromagnetic spectrum available for wireless telegraphy;

ii) the economic and other benefits that may arise from the use of wireless telegraphy;

iii) the development of innovative services; and

iv) competition in the provision of electronic communications services.[21]

2.18 Under the Wireless Telegraphy Act Ofcom may revoke or vary any wireless telegraphy licence, if: (a) the standards and procedures of Schedule 1 to the Wireless Telegraphy Act are met; and (b) the terms and condition of the licences do not curtail our ability to revoke/vary the licence.

2.19 Further detail on the relevant legal framework is set out in Annex 1 of this Statement.

[21] Please refer to section 3 of the Wireless Telegraphy Act.

3. The unpaired 2100 MHz spectrum

Introduction

3.1 In this section we set out, in the context of our duties, the policy objective we are seeking to achieve when considering the future use of the unpaired 2100 MHz spectrum. We then consider what we think is the optimal use of the band, how this can be secured and the impact on existing and future spectrum users. For each of these considerations we summarise the provisional views set out in our March 2023 consultation and stakeholder responses to these, followed by our conclusions and supporting rationale.

Our policy objective

3.2 We have decided to maintain the policy objective on which we consulted in our March 2023 consultation.

3.3 The unpaired 2100 MHz spectrum has not been used since it was awarded in 2000 and current licensees have confirmed through consultation that they have no plans to use it for public mobile services except potentially for the ESN Gateway. In the context of our duties relevant to our spectrum management functions, we place particular weight on the duty to ensure optimal use for wireless telegraphy of the electro-magnetic spectrum.

3.4 We therefore consider that our policy objective when considering the future use of the band should be to secure optimal use. We interpret optimal use to mean spectrum is used in a way that maximises the benefits that people, businesses and other organisations derive from its use, including the wider social value of spectrum.[22]

3.5 In assessing this, we have also had regard to the interests of everyone who may want to use the spectrum for wireless telegraphy, including how optimal use can be achieved in an efficient and timely manner. We have also considered the desirability of encouraging investment to enable citizens and consumers to benefit from the development of/investment in new wireless services.

Optimal use of the unpaired 2100 MHz spectrum

Our provisional view

3.6 In our March 2023 consultation, we said that the current non-use of the unpaired 2100 MHz spectrum for public mobile services and EE's potential use of its 4G licence for the ESN Gateway in the future, may not be optimal because there could be other higher value users of the spectrum. In reaching this view we noted that the spectrum had not been used since its award in 2000 and current licensees had indicated in our previous consultation[23] they had no plans to deploy high power public mobile services in the foreseeable future. We

[22] Ofcom's Spectrum management strategy for the 2020s, July 2021, paragraph 2.5.
[23] Annual licence fees for 2100 MHz spectrum, December 2021.

explained that we did not consider spectrum lying unused (and where it is not conceivable that it will be used in the future for public mobile services) as optimal when there are potential alternative uses for that spectrum.

3.7 As the unpaired 2100 MHz spectrum supports mobile technology we said it could be used for a range of applications, other than public mobile networks. We said we considered that the 1900–1915 MHz band could be used for other high power uses and that 1915–1920 MHz could be used for lower power use.

3.8 In view of this we said national infrastructure uses, focused on public safety (as the ESN Gateway) that use high power, such as rail and utilities, may be the most optimal future use of the 1900–1915 MHz spectrum. We explained that these high power uses could use the spectrum more intensively and therefore are more likely than not to generate more benefit to society than the ESN Gateway (a medium power application, used on an ad-hoc temporary basis and confined to specific locations where required) alone. We noted that the spectrum could be used to support key national infrastructure services that are important to almost all consumers and citizens in the UK and are therefore of high societal value.

3.9 We also noted that that the 1900–1910 MHz band has been harmonised in Europe for railway communications which means that any future rail communication services deployed in the UK in this band would be able to draw from a developing equipment ecosystem. Our provisional view therefore was that while the potential ESN Gateway use of EE's 4G licence in the 1900–1910 MHz band could play an important future public safety role when required, it may not be the optimal use of this spectrum on its own.

3.10 Our provisional view was that it is unlikely that the ESN Gateway could co-exist with other high power uses in the same frequency band (due to the ad-hoc nature of its use and the importance of it functioning when needed, usually at very short notice which could make it impractical to co-ordinate with future high power users). We explained that we thought there may be other spectrum capable of supporting the ESN Gateway and that we are undertaking work to assess the alternative spectrum options for the ESN Gateway beyond 1900–1915 MHz.

3.11 We received 16 responses to our consultation. One stakeholder - The Department for Transport/DfT - submitted a confidential response and some stakeholders - BT (parent company of EE), H3G, Vodafone and VMO2 - provided responses which were confidential in parts.[24]

Summary of consultation responses

Use by current licensees

Public mobile services

3.12 VMO2 suggested there may be some prospect of mobile use.[25] It disagreed with our view that high power mobile use in the band was 'inconceivable' as there may be opportunities for future use, especially if one MNO has access to 15 MHz of spectrum.[26] ✂

[24] All non-confidential responses to the consultation can be found here: https://www.ofcom.org.uk/consultations-and-statements/category-1/future-use-of-the-unpaired-2100-MHz-spectrum

[25] VMO2, p.4.

[26] VMO2, p.5.

3.13 H3G considered that the only use of the 1915–1920 MHz spectrum is as a guard band to mitigate interference from TDD spectrum below 1920 MHz into H3G's FDD spectrum above 1920 MHz.[27]

The ESN Gateway

3.14 The Home Office noted that the ESN is a government priority and explained how the ESN Gateway enables "100% assured geographical coverage for emergency services to carry out their mandate of saving lives and property".[28] Both the Home Office and BT noted that the Gateway solution has been developed to operate in EE's 1900–1910 MHz spectrum with the Home Office indicating that it is ready for use and that it anticipates a steady uptake of gateway devices when emergency service users migrate to ESN from the current Airwave network.[29]

Potential future uses of the spectrum

Rail communications

3.15 Cellnex, Network Rail and Nokia noted harmonisation of the 1900–1910 MHz band in Europe for railway communications[30] to support FRMCS (Future Railway Mobile Communication System[31]) and the benefits to the UK (if aligned) it would deliver by enabling access to mainstream solutions and economies of scale in equipment supply chains, creating cost efficiencies and reduced risk in the rail industry.[32] Network Rail argued that alignment "will provide the British rail industry with the stability that it needs to execute on a complex programme of migration, whilst enabling it to develop firmly defined strategic plans for future operations."[33] Without access to scaled solutions, Network Rail considered both costs and risks could rise to unreasonable levels while Cellnex noted there would be "considerable economic and operational disadvantages" if an alternative spectrum band were to be used.[34] Nokia noted that a decision on the spectrum should consider the best option that enables the UK to have access to an existing/developing ecosystem and if local options were considered the likely costs and timeline associated with developing a market specific ecosystem should be evaluated.[35]

3.16 The importance of FRMCS was noted by Network Rail and Nokia, including improved safety and operational efficiency, along with accelerated digital transformation of railway communications.[36] Without these systems, Network Rail argued, "there is potential for significant harm to the nation's railway workers, passengers, and high value assets. In short, failure (of RMR[37] systems) is not an option."[38]

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[27] H3G, p.2.
[28] Home Office, p.1.
[29] Home Office, p.1; BT, p.3.
[30] ECC Decision (20)02 on Harmonised use of the paired frequency bands 874.4–880.0 MHz and 919.4–925.0 MHz and of the unpaired frequency band 1900–1910 MHz for Railway Mobile Radio (RMR).
[31] An advanced communications system which will replace the currently used GSM-R system.
[32] Cellnex, p.4; Network Rail, p.1–2; Nokia, p.1.
[33] Network Rail, p.8.
[34] Network Rail, p.2.
[35] Nokia, p.2–3.
[36] Nokia, p.1; Network Rail, p.2.
[37] Railway Mobile Radio (RMR) – the overarching term for GSM-R and FRMCS. GSM-R: Global System for Mobile Communications Railways - a 2G based wireless technology specific for railway voice and data communications, used in the harmonised paired spectrum bands 876–880 MHz and 921–925 MHz.
[38] Network Rail, p.5.

3.17 Network Rail highlighted that lack of access to the harmonised spectrum would be directly counter to UK government stated priorities to maximise the UK's influence at international spectrum negotiations, through alignment with international and domestic spectrum frameworks where possible, so as to deliver access to future technologies and ensure that the UK's interests are reflected in global standards and decisions.[39]

3.18 Given the long development and change cycles within the rail sector, Network Rail noted planning work on the migration from GSM-R to FRMCS is already underway, with similar activity by authorities and industry across Europe and more widely.[40] Trials are expected to start in early 2025 onwards according to Cellnex, with migration to start from 2027 onwards in advance of GSM-R becoming obsolete in the 2035–40 period.[41]

3.19 Network Rail noted that alternative approaches were being explored to support GSM-R to FRMCS migration within the 900 MHz band, but that neither of the niche solutions were commercially proven at present and both were likely to drive up risks and costs and there was no guarantee of success or efficient use of public funds.[42]

3.20 Network Rail highlighted the "high societal value" of rail, noting factors such as access to employment and education, protection of the environment, well-being, and health and that there are 1 billion passenger rail journeys (excluding freight) per year in Great Britain.[43]

3.21 In addition to the 1900–1910 MHz band, Cellnex considered that there was the potential for rail to require up to 20 MHz of contiguous spectrum and therefore the entire band (1900–1920 MHz) to support higher capacity safety critical applications (e.g. live CCTV feeds from Level Crossings to trains) and to ensure a "future-proofed" outcome and roadmap for UK rail over the long term.[44]

3.22 On the Brighton mainline, Cellnex, as a neutral host provider, noted the infrastructure it is deploying for public mobile coverage assumed use of sub 2 GHz MNO spectrum, therefore if 1900 MHz spectrum is allocated to rail this infrastructure could be reused "as inter site distances and other factors will already be optimised to this type of spectrum". It noted that they understood that a similar approach is planned for rollouts for the wider UK rail network.[45]

Utilities communications

3.23 Most utility stakeholders (JRC, EUTC, NI Electricity) considered that the 1900 MHz spectrum would not support the geographic nationwide coverage that utilities require but along with NI Water considered it may have potential as a supplementary band to sub-1GHz spectrum.[46] Similarly, Sateliot did not consider that nationwide coverage for utilities could be achieved by terrestrial high-power services alone using 1900 MHz spectrum.[47]

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[39] Network Rail, p.7. UK Wireless Infrastructure Strategy, April 2023.
[40] Network Rail, p.8.
[41] Cellnex, p.4.
[42] Network Rail, p.9.
[43] Network Rail, p.6.
[44] Cellnex, p.4.
[45] Cellnex, p.5.
[46] JRC, p. 2–3; EUTC, p.2–4; NI Electricity, p.1; NI Water, p.1.
[47] Sateliot, p.2.

3.24 NI Electricity and Nokia noted using 1900 MHz spectrum would require significant additional investment to deploy the required number of base stations to address coverage and availability requirements.[48]

3.25 Vodafone suggested the most cost and spectrum-efficient method for utilities would be to use public communications networks where possible (engineered to meet the required power resilience) and only dedicated networks where the needs of the utility sector cannot be met. A similar point (as noted below) was made by BT.[49]

3.26 Several stakeholders (JRC, EUTC, NI Electricity, NI Water) noted there was no utilities ecosystem of hardware vendors available for the 1900 MHz spectrum, which according to JRC would inhibit (possibly completely) any actual deployments or would take in excess of 10 years to build the system, which, according to NI Electricity, would not fulfil the requirements to meet 2030 government targets.[50]

3.27 JRC, EUTC and Nokia noted that the low power requirement in 1915 MHz–1920 MHz would not suit utilities given their requirement is for nationwide coverage and it would limit the usefulness of the benefits of 5G, such as low latency. However, JRC and EUTC noted that if 1910 MHz–1920MHz was found to be "orphaned" and unsuitable for 3GPP technologies, then alternative uses could be explored. Both stakeholders considered that further analysis for utilities would need to be undertaken to determine whether it would be optimal use (given such spectrum is not being used elsewhere in Europe for utilities and the technical constraints of the band) and which applications it might fulfil.[51]

3.28 EUTC suggested Ofcom engage with CEPT "to assess whether there might be benefits in redesignating this band on a European basis for utility operations." EUTC pointed to the use of point to multipoint systems in other countries and suggested input from vendors was required to develop flexible products specifically for utilities.[52]

3.29 Sateliot argued that the band was well suited to deliver nationwide coverage for utilities using IoT/satellite connectivity given it was inherently a low power service.[53]

Other use

3.30 Sateliot suggested that the unpaired 2100 MHz spectrum, particularly the 1915–1920 MHz was ideally suited to satellite IoT applications and devices.[54]

Views on optimal use of the spectrum

Public mobile services

3.31 Several respondents (Network Rail, TfL, Cellnex, NI Water, JRC and Sateliot) agreed that given the possible alternative uses of the spectrum, the current non-use of the unpaired 2100 MHz spectrum for high power public mobile services is not optimal.[55] Network Rail noted there was presently no clear demand for high power public mobile services and a lack of equipment ecosystem for mobile use in the band. It argued that the limited TDD

[48] NI Electricity, p.1.
[49] Vodafone, p.3; BT, p.5.
[50] JRC, p.3; EUTC, p.3; NI Electricity, p.1; NI Water, p.1.
[51] JRC, p.2; EUTC, p.4; Nokia, p.2.
[52] EUTC, p.4.
[53] Sateliot, p.1–3.
[54] Sateliot, p.2.
[55] Network Rail, p.4; TfL, p.1; Cellnex, p.3; NI Water, p.1; JRC, p.2; Sateliot, p.1.

bandwidth was of little use to commercial MNOs and the mitigation required to address interference limited the usefulness of the band for consumer mobile services.[56] EUTC said that if spectrum remains dormant for decades the basis for the original allocation should be reviewed.[57]

3.32 VMO2 considered there is some prospect of future mobile use (in addition to the ESN Gateway) and rail communications in the band (e.g. high power mobile use of 1900–1915 MHz and ESN Gateway use of 1915–1920 MHz spectrum) and that because of this we had incorrectly assessed the differing potential future uses and the values that can be derived from these uses.[58] H3G said it is not foreseeable that the 1900–1915 MHz spectrum would be used for medium or high-power mobile use in the future given the potential to interfere with adjacent paired 2100 MHz mobile spectrum.[59]

3.33 BT stated that for the 1910–1920 MHz it is "unclear whether the present non-use is optimal or not given the technical limitations on the band, and whether it could become more efficiently used if the technical restrictions were varied".[60]

Alternative uses

Rail communications

3.34 Six stakeholders (Cellnex, JRC, EUTC, Network Rail, Nokia and TfL) considered that use of the 1900–1910 MHz for rail communications would be the most optimal while Sateliot agreed that the band could be used to support key national infrastructure services such as rail and utilities.[61]

3.35 Vodafone agreed with the principle of using the spectrum for rail and VMO2 indicated that, in its view, rail is the most promising of the alternative uses.[62]

3.36 BT disagreed and argued that there is no clear evidence of alternative demand and even if it exists, it is not clear it would represent a higher value use of the spectrum than EE's intended use for the ESN Gateway. BT is also of the view that alternative high power applications, such as rail and utilities, could be most efficiently provided using existing public mobile networks, similar to how ESN services are provided and that dedicated spectrum for utilities is "unlikely to represent an optimum technical or commercial solution, particularly in this band where it is not clear that alternative high power uses of the band could be made compatible with adjacent services".[63]

3.37 H3G and Vodafone outlined coexistence issues between high power rail use with mobile services in adjacent spectrum.

a) Vodafone said it was concerned that the coexistence analysis at CEPT had not fully accounted for the issue of interference to mobile services in the FDD band. It pointed to analysis done by its other European MNOs which raised concerns about interference from FRMCS usage to uplink services in the adjacent FDD band and in the extreme to the 1800 MHz downlink. It noted that additional selectivity (of 42dB) was required in their

[56] Network Rail, p.2–3.
[57] EUTC, p.1.
[58] VMO2, p.5.
[59] H3G, paragraph 2.24.
[60] BT, p.4–5.
[61] Cellnex, p.4; EUTC, p.2; Network Rail, p.4; JRC, p.2; Nokia, p.1; TfL, p.1; Sateliot, p.1.
[62] Vodafone, p.3. VMO2, p.6
[63] BT, p.6.

equipment where mast sites are within 500m of a FRMCS base station and that mitigation is required even where the separation exceeds 3km.[64]

b) H3G said its analysis indicated that there could be potential interference to its services in the FDD band from high power users in the 1900–1915 MHz range — primarily due to downlink traffic from a TDD base station. It called for specific out-of-band emissions and coordination requirements (as stated in CEPT and ECC reports), to mitigate such interference concerns for high power use in the 1900–1915 MHz band.[65]

3.38 Network Rail noted the CEPT Decision on harmonisation of the 1900–1910 MHz band is on a non-exclusive basis and therefore the band could be made available to other users where rail communications is not required, subject to a decision by the national regulator. It noted that spectrum sharing involving high power services is likely to present some challenges with radio planning and risk of interference and would require careful management of radio power levels, and that existing regulations do not provide for band sharing other than at low and medium power levels. Given the critical nature of its wireless system to rail operations, Network Rail considered any sharing would require "significant geographical boundaries between Network Rail operational areas and other shared spectrum operators" but it was open to discussing with Ofcom the potential for spectrum sharing as well as alternative related options such as active network sharing and service slicing.[66]

3.39 Nokia suggested an alternative option would be a framework that allows for shared use of the spectrum and network capacity between FRMCS and utilities.[67]

ESN Gateway

3.40 Cellnex, Network Rail and NI Water agreed with our provisional view that use of the 1900–1910 MHz spectrum for the ESN Gateway may not be optimal given the possible alternative use cases of the spectrum.[68] Network Rail noted that the ESN continues to suffer significant delays and remains undeployed.[69]

3.41 BT disagreed, stating that the ESN Gateway will be the optimal use of 1900–1910 MHz. BT further questioned whether moving the Gateway to the top of the band (alongside alternative uses in the rest of the band) was technically viable or would achieve Ofcom's objectives and statutory duties. It noted that the current permitted in-band EIRP limit (43dBm/5MHz) for 1899.9 MHz–1904.9 MHz in the EE licence was sufficient to provide the coverage required by the emergency service, but the lower power limit currently permitted in 1910 MHz–1920 MHz would make this band unsuitable for delivering the coverage required by the gateway.[70]

3.42 The Home Office noted that while alternative spectrum is a possible option, it was concerned that this would increase ESN costs and timelines.[71]

[64] Vodafone, p.3.
[65] H3G, paragraph 1.9.
[66] Network Rail, p.3–4.
[67] Nokia, p.1.
[68] Cellnex, p.3; Network Rail, p.3; NI Water, p.1.
[69] Network Rail, p.3.
[70] BT, p.3 and p.4.
[71] Home Office, p.1.

Our reasoning and decision

3.43 We have considered the optimal use of the unpaired 2100 MHz spectrum in light of stakeholder views.

Public mobile services

3.44 With regards to the prospect of the future use of the spectrum for public mobile services:

a) As noted in the consultation, our understanding remains that although licensed in many countries the spectrum remains unused in Europe since award and in many countries the licences have been surrendered. Without European harmonisation of this band for high power public mobile services (which we have no evidence of work to achieve this) we do not consider that there is a realistic prospect of a mobile equipment ecosystem emerging in this band in the foreseeable future.

b) Although VMO2 said we should not dismiss future mobile use in the band, ✂. None of the other mobile operators indicated any interest to deploy (or acquire more spectrum for) public mobile services in this spectrum.

c) We note that most stakeholders who commented on the uses of the spectrum for high power mobile services agreed current non-use of the unpaired 2100 MHz spectrum for high power public mobile services is not optimal. The lack of an equipment ecosystem, limited bandwidth and interference concerns, among other factors, are cited as reasons for this lack of use, with H3G stating their unpaired spectrum is unused in order to protect their adjacent paired spectrum from interference.

3.45 Given the above we do not think there is a realistic prospect of future high power mobile use in this band and we do not consider spectrum lying unused, as has been the case for over 20 years, with no realistic prospect of it being used for the service it was originally authorised for, as optimal.

Alternative use

3.46 We have also considered whether the planned use of the 1900–1910 MHz spectrum for the ESN Gateway would be optimal having regard to potential future uses of the spectrum.

3.47 We note that most stakeholders, including those from rail, utilities and some mobile operators, were of the view that rail is likely to be the optimal use of the 1900–1910 MHz spectrum. European standardisation is mostly complete, equipment vendors are developing an ecosystem and countries have committed to trials. Network Rail stated there is a need for access to this spectrum to support the deployment of FRMCS and the need to start the migration from GSM-R from 2027 onwards. Only BT were of the view that the ESN Gateway is the optimal use of the spectrum.

3.48 We remain of the view that while ESN Gateway use of EE's 4G licence in the 1900–1910 MHz band could play an important future public safety role when required, it is not the optimal use of this spectrum on its own. In our view, the benefits of using the 1900–1910 MHz for rail communications (which similarly provides safety critical services) would be significantly higher. In reaching this view, we have considered:

a) Use of the 1900–1910 MHz spectrum for the ESN Gateway (which is a coverage extender) will be for a medium power application on an ad-hoc and temporary basis and confined to specific locations where required. In contrast, FRMCS, which will eventually replace GSM-R across the whole rail network, would be a high power application that

could use the spectrum more intensively. It would support a wide variety of services in different scenarios, including signalling and communications, the control of trains and communications for railway workers and in doing so, support services that are of high social and economic value.[72]

b) Harmonisation of the 1900–1910 MHz for rail communications in Europe means any future rail communications services deployed in the UK in this band would benefit from economies of scale in equipment supply chains and cost efficiencies and access to mainstream solutions. Without access to the spectrum we note stakeholders considered the value of the FRMCS would be undermined and the costs and risks associated with the rollout of FRMCS may rise to unreasonable levels.

c) The ESN Gateway as a bespoke product developed for a socially valuable but specific use case is better positioned to take advantage of other spectrum that also support LTE technology and the impact of moving it to another band is likely to be simpler and significantly less costly than the development of a customised ecosystem for FRMCS services if it uses spectrum other than that harmonised for rail communications use in Europe.

3.49 We have also considered whether it is possible for the ESN Gateway to share with future rail communications and do not consider that it is possible for the ESN Gateway use to co-exist with high power rail use in the same frequency band (co-channel). We have not seen evidence of the viability of the ESN Gateway sharing with rail where both are operating independent networks, given that both are safety critical services with the former requiring spectrum on an ad-hoc basis.

3.50 The ESN Gateway and future rail communications could potentially share the same spectrum if operating on the same network. We note the suggestion from Network Rail on potential spectrum sharing as well as alternative related options such as active network sharing and service slicing which is also mentioned by Nokia with regards to sharing between utilities and FRMCS. Whilst we agree that greater spectrum sharing could be achieved through such techniques, we recognise this would require a commercial agreement between both parties that meets the requirements of both services as well as any practical implementation considerations. In our view this would be very challenging to achieve and therefore there would be a high risk that an agreement cannot be reached, particularly within the timescales required.

3.51 We consider that there is likely to be other spectrum capable of supporting the ESN Gateway outside the 1900–1910 MHz band. We note BT's comment regarding the lower power limit in 1910–1920 MHz which it considers to be unsuitable for delivering the coverage required by the ESN Gateway. We note that this was based on a previous decision (see paragraph 2.6). We recognise that the medium power requirement for the ESN Gateway may make the 1915–1920 MHz less suitable in order to coexist with adjacent paired 2100 MHz spectrum above 1920 MHz. However, our technical analysis now suggests that 1910–1915 MHz could

[72] Over 1 billion passenger rail journeys made in Great Britain per year: https://dataportal.orr.gov.uk/popular-statistics/how-many-people-use-the-railway/. Rail freight contributed £2.45bn to the UK economy in 2018/19 – based on report published by the Rail Delivery Group (RDG), based on independent research by Deloitte; https://www.raildeliverygroup.com/media-centre-docman/12807-2021-04-role-and-value-of-rail-freight/file.html

be a potentially viable option for the ESN Gateway which would not cause harmful interference to adjacent paired 2100 MHz spectrum.

3.52 With respect to other comments made relating to the future use of the spectrum:

a) On the 1910–1920 MHz band, we note suggestions from stakeholders on the potential future use of this portion of the band — from Cellnex on safety critical rail applications (although we are not aware of any international developments to extend rail use beyond 1910 MHz) and the 1915–1920 MHz spectrum for satellite IoT from Sateliot. We would take this into consideration in any future allocation of the spectrum to new users and consider that new use cases (once established) are more optimal than the existing non-use.

b) We note that some stakeholders were concerned about interference from alternative future users of the band to the adjacent bands above 1920 MHz, including H3G's view that the 1915–1920 MHz spectrum can only be used as a guard band. We recognise the importance of protecting services above 1920 MHz from harmful interference and we are of the view that low power use is possible in the 1915-1920 MHz band (beyond a guard band). As above, in determining any future allocations of the spectrum to new users we would consider relevant factors, including any potential harmful interference and appropriate mitigations.

c) We note different views on the suitability of the 1900 MHz spectrum for utilities[73]. Regarding BT's suggestion that national infrastructure uses, such as rail and utilities, could be best supported by a public network, we consider this would be best determined through consultation with relevant stakeholders, including with government in the context of the technology and funding available at the relevant time.

Conclusion

3.53 We consider the current non-use of the unpaired 2100 MHz spectrum for public mobile services with no plans for future mobile use is not optimal.

3.54 With regards to the planned use of the 1900–1910 MHz spectrum for the ESN Gateway, our view is that it is not the optimal use of this spectrum on its own. In addition, we have not seen evidence of the viability of the ESN Gateway sharing with rail. Based on ongoing standardisation in Europe and the ecosystem development that is underway we consider that rail communications (possibly in combination with other uses if they can coexist without causing harmful interference) would be optimal use of the spectrum.

3.55 With regards to the 1910–1920 MHz spectrum, we consider that alternative use of this spectrum (once established), which may include taking into consideration some of the suggested uses as noted above, will be more optimal than the existing non-use.

[73] Ofcom sought views on potential candidate spectrum bands that might be suitable to support the future operational communications needs of the utilities sector, should spectrum for a private network be required: Call for Input: Potential spectrum bands to support utilities sector transformation, June 2023. We published a post-CFI update on this webpage on 24 November 2023.

How to secure optimal use of the unpaired 2100 MHz spectrum

Our provisional view

3.56 In our consultation we stated it is possible that optimal use could be achieved by liberalisation and trading if existing licensees were incentivised to trade, if there were more valuable uses of the band, and other users were willing to pay more than existing licensees' valuations of their licences. However, our provisional view was that there were potential complexities to achieving optimal use in this way, which would make stakeholders less inclined to trade and make it harder for those parties involved to coordinate and develop an appropriate solution, such that we could not rely on them to achieve our policy objective.

3.57 We also noted in our consultation that there are limits to a market-based approach (liberalisation and trading in this context) and that there is an important and complementary role for Ofcom to play in ensuring optimal use of spectrum when major changes (such as those considered in the consultation) are being contemplated and frequencies need to be recycled.[74]

3.58 We considered that revocation of the unpaired 2100 MHz spectrum licences to enable reallocation of the spectrum to future users may be more likely to meet our objective, and that were we to take such an approach, it would be objectively justified and proportionate.

Summary of consultation responses

Assessment of liberalisation and trading to achieve our objective

3.59 Eight stakeholders (Network Rail, Cellnex, EUTC, JRC, NI Water, Nokia, Maxxwave and Sateliot) agreed with our provisional view that liberalising the licences and relying on trading is unlikely to secure the optimal use of the spectrum.[75]

a) Network Rail said the potential for varied uses would result in high risk and complexity levels if left to trading and argued that "trading rarely works well in practice, as commercial positioning, administrative delays, and variations in technical consumption can drive complexities." It further argued "spectrum trading cannot be applied effectively to the rail sector, where national coverage and system resilience are fundamental requirements, and adherence to international standards is required".[76]

b) JRC suggested the low economic value of the spectrum provides insufficient incentive for the current licensees to invest management time in its disposal or redeployment.[77]

c) Cellnex was of the view that trading was unlikely to work as all three spectrum owners would need to align on a transfer strategy.[78]

[74] Supporting the UK's wireless future - Our spectrum management strategy for the 2020s, July 2021, paragraph 2.19.
[75] Network Rail, p.9; Cellnex, p.6; EUTC p.2; JRC p.2; NI Water, p.1; Nokia, p.2; Maxxwave, p.1; Sateliot, p.2.
[76] Network Rail, p.9.
[77] JRC, p.3.
[78] Cellnex, p.6.

d) Several other stakeholders questioned the ability of trading to deliver optimal use based on the success of trading activity in the past (Cellnex, EUTC, JRC).[79] Nokia said secondary markets in Europe are "nascent and characterised by lengthy processes"[80] while Maxxwave noted that regulatory intervention is often required to give the maximum benefit for the general public.[81]

3.60 Four stakeholders (BT, H3G, VMO2, Vodafone) disagreed with our view, saying market mechanisms (liberalising the licences and trading) should be used to deliver optimal use. In their view, we had underestimated the economic incentives for the current licensees to trade and had overstated the complexities of trading.

a) H3G and VMO2 both argued that existing licensees have no strategic reasons to not trade the spectrum to a user that has a greater value for the spectrum, given alternative users were unlikely to be direct competitors.[82]

b) VMO2 suggested if EE wants to hold onto its spectrum for the ESN Gateway, "this can be the optimal outcome if it derives greater value from such use" compared to alternative users. Conversely, if other parties derive greater value from their prospective uses, incentives for EE to monetise its spectrum would be expected to overcome any initial inclination to hold onto its spectrum licence. It highlighted the transfer of spectrum between MNOs as evidence that MNOs are willing to engage in spectrum trades.[83]

   H3G and VMO2 considered that H3G should be willing to trade its spectrum if other parties derive greater value from it than H3G, subject to appropriate interference management with adjacent paired 2100 MHz spectrum. Additionally, H3G said that its 1915–1920 MHz spectrum could not be traded as it was unusable because any use would interfere with H3G's adjacent FDD spectrum; liberalisation and trading could only occur if there are sufficient technical advancements to remove the risk of interference to the FDD spectrum.[84]

c) VMO2 said that Ofcom had overstated the suggestion that adopting a market mechanism does not allow parties to manage interference across different users as the conditions to protect adjacent services would be part of the terms of the licence. It noted that Ofcom could define the required protection of the paired 2100 MHz spectrum in future licensing of unpaired 2100 MHz spectrum, which would remove uncertainty either through regulatory intervention or use of a market mechanism. H3G made a similar point, noting that interference issues would not be an issue with regards to the 1915–1920 MHz band as the spectrum would only be re-purposed if coexistence conditions allowed (which it argued did not exist today).[85]

d) BT considered that trading had not taken place to date primarily due to a lack of demand for the spectrum which it suggested could be due to the restrictive technical conditions of the licence and that mobile equipment is not available. It advocated Ofcom reviewing

[79] Cellnex, p.6; EUTC,p.2; JRC, p.2.
[80] Nokia, p.2.
[81] Maxxwave, p.1.
[82] H3G, paragraph 2.5; VMO2, p.8–9.
[83] VMO2, p.8.
[84] H3G, p.14; VMO2, p.8.
[85] VMO2, p.7–9; H3G, paragraph 2.22.

the technical constraints with a view to liberalising and relaxing the technical conditions to the extent possible where requested by licensees.[86]

e) The number of potential parties was not considered by Vodafone and VMO2 to be a barrier to trading as there are only two existing licensees that hold spectrum suitable for high power use such that alternate users could secure 5 MHz or 10 MHz of TDD spectrum via negotiation with a single licensee.[87] VMO2 noted that this argument was further weakened by the fact the interested parties (MNOs and rail stakeholders) already work together and have existing relations and there are prospects for future collaboration (beyond a spectrum trade).[88]

Revocation and reallocation of the unpaired spectrum

3.61 Six stakeholders (Network Rail, Cellnex, EUTC, JRC[89], NI Water, Sateliot[90]) agreed with our provisional view that revocation of the licences to enable reallocation is necessary. Network Rail and NI Water argued that given the current non-use of the spectrum, revocation was appropriate.[91] Cellnex noted that it was the "least worst" option for achieving optimal use.[92] EUTC said such action was justified "particularly where there is an alternative societal use of the vacant spectrum which is being obstructed by the failure of market mechanisms to facilitate optimum use of valuable spectrum". In its view Ofcom should have acted sooner to recover the spectrum given it has remained unused for 20 years and noted that revocation is increasingly being used by other regulators where an organisation is holding spectrum but not using it (citing the example of the 450–470 MHz band in Brazil).[93]

3.62 The three existing licensees — BT (EE), H3G and VMO2 — disagreed with our provisional view that revocation is the most appropriate action. In particular, as set out in more detail below, they considered we had understated the risks of regulatory intervention, and queried whether revocation in this case was objectively justified and proportionate.

3.63 BT, Vodafone and VMO2 suggested we allow more time to see if trading would work. Specifically:

a) BT suggested we work with licensees to review how the technical conditions might be relaxed and then allow a period of time for the market to operate to explore more optimal uses in future. In its view, only if this market based-approach fails should we reconsider moving to take some/all of the spectrum back for possible new authorisations or awards. It also argued that non-regulatory options such as leasing should be considered alongside the use of trading. H3G also argued that we had been too quick to dismiss leasing as a possible option (along with trading).[94]

b) Vodafone suggested we should set an Annual Licence Fee (ALF) for the current licences based on the value of the alternate users (either by willingness-to-pay or by Ofcom

[86] BT, p.6.
[87] VMO2, p.9; Vodafone, p.2.
[88] VMO2, p.13.
[89] JRC, p.3.
[90] Sateliot, p.2.
[91] Network Rail, p.10; NI Water, p.1.
[92] Cellnex, p.7.
[93] EUTC, p.1 and p.3.
[94] BT, p.2.

research) and leave it to the incumbent licensees to decide whether to retain the spectrum and pay the fee, return the spectrum to Ofcom, or trade it to a third party.[95]

c) VMO2 suggested we give trading an opportunity by shortening the revocation notice period (e.g. to two years) and commit to only give notice of revocation if no trading occurs after three years from publishing the Statement. It argued this would achieve the same effect of licences being revoked now with 5 years notice and would enable them to explore trading more in the meantime. It noted that regulatory processes can be used to improve incentives to trade, an example of this being in the 700/3600 MHz auction.[96]

Whether revocation is objectively justified and proportionate in this case

3.64 BT's view is that a "a high hurdle" must be overcome before regulatory intervention can be justified and where regulatory intervention is justified the aim should be of the least intrusive means in achieving the objective, recognising the potential for regulation to reduce competition. It queried whether we had followed our own or the UK Government's guidance on impact assessments in the consultation, as in doing so we would have been biased against intervention and considered a range of options for intervention including lighter touch approaches.[97]

3.65 In VMO2's view, regulatory intervention can only be appropriate when utilisation by existing licensees is limited, existing licensees have other ways to meet their needs and alternative use by other parties is highly valuable. It considered that whilst the unpaired 2100 MHz was not currently used, prospects of differing potential future uses are subdued and subject to great uncertainty, and that it is not clear that the value of alternative uses exceeds that of uses available to existing licensees. In its view, revocation was therefore not required to unlock new uses that could not otherwise be supported and that regulatory intervention was neither necessary nor appropriate.[98]

3.66 H3G argued revocation was "a highly intrusive regulatory option which represents a dramatic departure from the value that Ofcom has historically put on market mechanisms to allocate spectrum efficiently".[99] In relation to its spectrum holding at 1915–1920 MHz, given its view that it would need to remain unused to protect its paired 2100 MHz spectrum, it considered that it was not proportionate to revoke the spectrum as doing so would impose a cost on H3G without any corresponding benefit.[100]

3.67 In addition, Vodafone considered we had taken a "somewhat binary approach" in our assessment and that our provisional view showed a lack of faith in market mechanisms to deliver optimal use and whether, in combination with our work on mmWave, we were becoming more interventionist.[101]

View on risks of regulatory intervention

3.68 VMO2 said it generally cannot be assumed that regulatory intervention will perform to the same level as the market in securing optimal spectrum use, with regulatory intervention being highly dependent on Ofcom being able to identify and decide on the uses that deliver

[95] Vodafone, p.2.
[96] VMO2, p.12–13.
[97] BT, p.5.
[98] VMO2, p.11–12.
[99] H3G, paragraph 2.8.
[100] H3G, paragraph 2.14.
[101] Vodafone, p.2.

most value. It considered that when that ability is impaired, regulatory intervention may not deliver as optimally on spectrum use as we implicitly presumed. It also considered that market mechanisms were more likely to make the spectrum available faster than regulatory intervention.[102]

3.69 BT also considered that we had understated the risk of regulatory failure arising from revocation of licences. [103] With regards specifically to the 1915–1920 MHz spectrum BT noted that H3G as the licence holder of this spectrum, in addition to the adjacent FDD spectrum, "might have an incentive to agree technical parameters in a trading scenario, more so than if Ofcom revokes the licence and seeks to impose a solution".[104]

3.70 VMO2 cited the five-year notice period as a limitation of the revocation process as it would create a period when spectrum was unlikely to be used.[105]

3.71 In revoking the existing licences VMO2 argued this would effectively exclude mobile use and prevent ESN Gateway use at a different position in the band — which could lead to a large inefficiency if potential mobile use were to develop in the future.[106] H3G and VMO2 also raised concerns about the wider implications on mobile spectrum licensees of us revoking these licences, arguing that it could impact on the industry's confidence in their property rights and hinder efficient long-term use and investment in spectrum.[107]

Our reasoning and decision

3.72 As noted above, there is no current prospect of public mobile use in the band twenty years on from the initial allocation. The planned use of the 1900–1910 MHz spectrum for the ESN Gateway is not optimal on its own, nor have we seen evidence of the viability of the ESN Gateway sharing with rail. An alternative user would, therefore, involve a change of use and we think there is an important and complementary role for Ofcom to play to secure optimal use in such circumstances in line with our duty. It is a matter of judgement how best to secure optimal use of spectrum in any particular case, including whether it is appropriate to rely on trading. This is consistent with our Spectrum Management Strategy.[108]

3.73 In reaching a view on how to secure optimal use of the unpaired 2100 MHz, we have separately considered 1900–1910 MHz and 1910–1920 MHz. We do this because of their differing factual contexts:

a) for 1900–1910 MHz the spectrum is not being used but there is a planned use case by the current licensee (the ESN Gateway) and a new, higher value alternative use case emerging for the spectrum (rail communications).

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[102] VMO2, p.10.
[103] BT, p.5.
[104] BT, p.4.
[105] VMO2, p.1.
[106] VMO2, p.5.
[107] H3G, paragraph 2.9; VMO2, p.11. H3G noted they had made a similar point in their response to the mmWave consultation: H3G's response to Ofcom's consultation on enabling mmWave spectrum for new uses, Aug 2022, p.7.
[108] Supporting the UK's wireless future - Our spectrum management strategy for the 2020s, July 2021, paragraph 2.19.

b) for 1910–1920 MHz, the spectrum is not currently being used by the current licensees, there is no realistic prospect of them using it in the foreseeable future, and there is also less certainty as to potential alternative uses.

1900–1910 MHz

3.74 Given that future use of the 1900–1910 MHz spectrum would be a change of use, we consider that there could only be a role for trading where there is a clear set of trades that would achieve our policy objective of securing optimal use. For the reasons set out below, we consider that there are complexities arising in this case that mean that we do not consider it appropriate to rely on trading and liberalisation to achieve our objective.

a) As highlighted by H3G and VMO2, we agree existing licensees could have an incentive to trade if (as we think) there are more valuable uses of the band, and other users were willing to pay more than existing licensees' valuations of their licences. As they highlighted, trades are most likely to be with users who are not direct competitors of the existing licensees, therefore it is unlikely licensees would be unwilling to trade for strategic reasons related to gaining a competitive advantage unless licensees are also looking to be the infrastructure provider for the new service.

b) On the other hand, we note BT's response that there is no evidence of alternative demand in the spectrum that it currently holds. While we disagree with this given rail harmonisation in the band since 2020 and ✂, this does suggest agreeing a trade may not be straightforward. BT's assertion that even if alternative demand exists, it would not represent a higher value use of the spectrum than BT's intended use for the ESN Gateway highlights potential differences between BT's belief about the valuation of the spectrum for the ESN gateway on one side, and that of rail stakeholders, which Network Rail highlighted as one potential complexity of trading.

c) Even if BT considers there is a higher value use of the spectrum than its intended ESN Gateway use, it may not be incentivised to trade given the wider strategic importance of the ESN contract, as well as the costs it has already incurred in developing a solution in the band.

d) If BT were to trade EE's spectrum, it would need to find alternative spectrum for the ESN Gateway, for example by trading with other licensees in the 1910–1920 MHz spectrum or elsewhere or seek to deploy the ESN Gateway in its other spectrum holdings. Moreover, if BT is to consider deploying the ESN Gateway in the 1910–1920 MHz spectrum, as Cellnex noted all three licensees would need to agree on a transfer strategy and H3G may be reluctant to trade its spectrum given its view that its spectrum is a guard band. Even if, as VMO2 suggested, we could address the interference between adjacent users through the setting of technical licence conditions in liberalising the spectrum, this does not remove the risk of delay and uncertainty in trading for new users to access the spectrum. In particular, we note the requirement from the rail industry for regulatory certainty and long-term stability given the long development and change cycles within the rail sector.

e) With respect to the potential transaction costs of a trade, we recognise there is a risk, as JRC suggests, that the gains from trading for the current licensees may potentially be small, such that they provide insufficient incentive for them to invest management time in negotiating a trade. While we disagree with BT's view that the existing licence conditions are a barrier to trade because it is open to licensees to request a variation to

their licence, we recognise that potential trades that require a change in licence conditions could increase the complexity and cost of such a trade.

3.75 Given the above, we retain our view that there is significant uncertainty as to the likelihood that trading will secure the efficient allocation of this band. We cannot, therefore, rely on trading to achieve our policy objective of securing the optimal use (currently viewed as supporting rail communications) of the 1900–1910 MHz spectrum in a timely manner. In reaching this view, we are mindful of the requirement from the rail industry for regulatory certainty and long-term stability given the long development and change cycles within the rail sector.

1910–1920 MHz

3.76 With respect to the 1910–1920 MHz spectrum, we note there is no current or planned future use of the spectrum by the current licensees, the initial period of the licence has ended, and there is currently less certainty as to potential alternative uses. Therefore, we do not see a clear role for trading at present.

3.77 We do not consider it appropriate for the existing licensees to retain the spectrum when they have no plans to use it and have already held it for 20 years without finding a use. Revoking the licence would enable us to consider proactively how spectrum might be used across the band in the future. We note this does not preclude the spectrum being reallocated to the existing licensees in future if they have a future use case.

3.78 We also note (as set out in the impact assessment of revocation on existing spectrum users section below) that the impact of revocation on VMO2 and H3G (as the current licensees) is likely to be minimal given neither licensee is operating nor has plans to operate any services in the band. We recognise the need to protect the adjacent paired spectrum use but do not consider it appropriate for the licensee to retain unused spectrum for this purpose. The appropriate mitigation against interference from any future use should be determined as part of the consideration of the most efficient allocation of this band in accordance with our duties.

Revocation and reallocation

3.79 Turning to stakeholders' responses on our proposal to revoke and the risk of regulatory intervention:

a) We do not agree that revoking these licences would be a departure from our longstanding market-based approach to spectrum management or that we are moving towards a more interventionist approach to spectrum management. Since our 2005 Spectrum Framework, our approach to spectrum management has been guided by the principle of relying on market mechanisms where possible and effective. We have also consistently stated that there is an important and complementary role for Ofcom to play in ensuring the optimal use of spectrum. We are not always able to rely on market mechanisms in all circumstances given the complex nature of spectrum interactions, for example when major changes of spectrum use (as is the case here) are being considered.

b) We also disagree with H3G and VMO2 that the five year revocation period is necessarily a limitation of the revocation process. The unpaired 2100 MHz licences (in common with our other Wireless Telegraphy licences) are not exclusive. This means that we could authorise new users to deploy as long as they can share with incumbent users, for

example under a local access licence[109]. The five years revocation notice period enables licensees who have deployed to clear their use by the end of the notice period and only restricts new users in so far as they would need to share with the incumbents. Since there is no planned deployment by existing unpaired 2100 MHz licensees for public mobile services, nor would we expect ✂ during the revocation period there is no impact on the ability of new users to deploy during the revocation notice period.

c) We do not consider that the suggestions to delay commencing the revocation process would represent the best way forward as we consider it is unlikely to increase the likelihood that trading would occur and is more likely to prolong uncertainty for potential future users.

d) We also do not consider that leasing (as suggested by BT and H3G) would be likely to secure our policy objective. We note that leasing is not currently permitted under the licence terms. Even if it were, as well as facing similar challenges to those identified above in relation to spectrum trading, spectrum leasing may not provide new users with the certainty required to make long-term investment decisions and as such it is unlikely to secure the long term efficient use of the spectrum.

e) Regarding H3G and VMO2's comments about industry's confidence in their property rights and investment certainty, we note that the wireless telegraphy licences granted under the Wireless Telegraphy Act 2006 are public law instruments that "constitute statutory authorisation permitting the licensees to undertake activities which would otherwise be unlawful"[110]. We note that the existing unpaired 2100 MHz licences have a clear clause enabling Ofcom to revoke such licences for spectrum management reasons by giving five years notice. Given there is, no current use and in our view, no realistic prospect of spectrum being used by existing licensees (other than for the ESN Gateway), we consider that spectrum should be reallocated to support efficient use and investment by new users in accordance with the legal framework.

f) We recognise, as VMO2 highlight, that there is a risk that revocation and reallocation may not secure optimal use and will depend on us being able to reallocate spectrum effectively. We consider that this risk will be mitigated by any future approach to reallocation being undertaken in line with our statutory duties and being subject to public consultation.

Conclusion

3.80 We consider that in this case where there are major changes of spectrum use, we are better placed to make future spectrum allocations and authorisation decisions to secure optimal use of the unpaired 2100 MHz spectrum and more likely than not to achieve this in a timely manner compared to relying on trading and liberalisation:

a) With respect to 1900–1910 MHz where we have identified rail use as the optimal use, we do not consider it appropriate to rely on trading to enable rail use of the band because of potential trading complexities to reach agreement, which could cause a delay in providing certainty to new spectrum users to make investment decisions. Therefore,

[109] A mechanism that enables the shared use of spectrum which is already licensed on a national basis to mobile network operators (MNOs), in locations where a particular frequency is not being used. More information can be found on the Ofcom website - Local access licences.

[110] See paragraph 88 of the judgment of the High Court of Justice dated 28 May 2010 in the Data Broadcasting International Limited case ([2010] EWHC 1243 (Admin)).

we consider that it is necessary for us to revoke the spectrum to enable future use and we will consult in due course on the future allocation of the spectrum.

b) With respect to use in 1910–1920 MHz, given it has not been used for over 20 years and there is no planned future use, we do not consider it is appropriate for the licensees to retain the spectrum. Rather it should be for Ofcom to revoke the spectrum so it can consider the most efficient future allocation in accordance with its duties.

Impact assessment

3.81 Impact assessments provide a valuable way of assessing different options for regulation and considering the potential effects of our proposals. In assessing the impact of our decision, we are fulfilling our obligation under Section 7 of the Communications Act and it is part of best practice policy making.[111]

3.82 We have taken into account all consultation responses and considered whether revocation and reallocation are the most proportionate and least intrusive means of achieving our objective of optimal use. This section outlines our assessment of how our decision may affect citizens and consumers as well as stakeholders operating in the industries we regulate and any impacts on specific groups of persons.

Our provisional view

3.83 In considering the likely impact of revocation and reallocation on the holders of the unpaired 3G 2100 MHz licences and on EE as the holder of the unpaired 2100 MHz 4G licence, our provisional view was that it would not produce adverse effects which would be disproportionate to achieving optimal use.

Summary of consultation responses

Potential impact on holders of unpaired 2100 MHz 3G licences

3.84 No stakeholders commented on our view that there are no costs incurred in clearing the band or migrating services to other bands given that the spectrum is currently unused and the licensees have no plans to deploy public mobile services in the foreseeable future using these licences.

3.85 H3G said that if its spectrum licence was revoked it would have the adverse effect of ✂.

Potential impact on EE as the holder of an unpaired 2100 MHz 4G licence

3.86 BT stated that the 1900–1910 MHz band is the only band available to EE that is suitable for the ESN Gateway product.[112] It also noted that substantial investments have been made to prepare the ESN Gateway using the frequencies assigned[113] ✂. The Home Office noted that EE's deliverables included gateway functionality, using EE's 2100 MHz unpaired spectrum and that EE had "designed, built, and verified this gateway capability to operate in EE's unpaired 2100MHz band".[114]

[111] Ofcom's impact assessment guidance, July 2023.
[112] BT, p.3.
[113] BT, p.5.
[114] Home Office, p.1.

3.87 Due to timescales available and the technical modifications required to achieve adjacent band compatibility being unknown, according to BT, it is not possible to provide the cost of moving the gateway to another frequency band.[115] ✂, while the Home Office noted a change will require redesigning and redevelopment of equipment increasing costs and timelines which will impact ESN deployment.[116] BT stated that moving the ESN Gateway to an alternative band could introduce delays to the ESN delivery.[117]

3.88 The Home Office was concerned that there was no assurance that LTE terminal chipsets supporting alternative spectrum would be available and that assigning a different spectrum band may require additional payments by EE which would likely be passed onto the ESN.[118]

Our reasoning

Potential impact of revocation and reallocation

Unpaired 2100 MHz 3G licences

3.89 In relation to the 3G licences held by each of the three mobile operators, we do not consider there would be any costs that are reasonably incurred because of our policy being implemented, given that the spectrum is currently unused (as noted in paragraphs 3.12 and 3.13) and none of the licensees suggested that there would be any such costs. Similarly, there is no impact to citizens and consumers given there are no services operating in the band.

3.90 In the consultation we recognised that existing licensees may obtain option value from the spectrum. We believe the societal benefits of the reallocation of the spectrum in the future would likely outweigh this value. We also note H3G's point ✂.

Unpaired 2100 MHz 4G licence

3.91 In terms of the benefits arising from our decision, as set out in paragraph 3.48 and 3.49 above, while we recognise the ESN Gateway could play an important public safety role, we do not consider it to be the optimal use of this spectrum on its own nor have we seen evidence of the viability of the ESN gateway sharing with rail. In other words, the societal value of rail use is likely to be greater than that which may arise from the spectrum being used for the ESN Gateway only.

3.92 BT advised that EE is currently planning to use its unpaired 2100 MHz spectrum for the ESN Gateway service and has already incurred some investment costs on product development. However, our impact assessments are intended to reflect the costs that are reasonably incurred because of our policy being implemented and not costs that are already 'sunk'.

3.93 If alternative spectrum is found for the ESN Gateway, then the 'value' derived from the ESN Gateway would be maintained, although there would still be costs associated with using the ESN Gateway in another band and these costs would arise because of our decision. We consider, as outlined in paragraph 3.51, that there are alternative spectrum options for the ESN Gateway outside 1900–1910 MHz.

3.94 We recognise that using the ESN Gateway in another band could lead to some incremental costs and potentially delays to timings. In particular, the new investment costs related to

[115] BT, p.3.
[116] Home Office, p.1.
[117] BT, p.4.
[118] Home Office, p.1.

product development and testing that may have to be incurred. While we recognise that it is difficult to quantify these costs in the absence of knowing where the ESN Gateway may be migrating to, our expectation is that ✂, it would be outweighed by the benefits of future rail usage (outlined above in paragraph 3.48). We also consider that by moving to revocation now, ✂, will help minimise the potential additional costs and potential delay. Additionally, we note that the Home Office is currently procuring a new supplier for the ESN, which means a change to the original timeline for ESN delivery.

Conclusion

3.95 It follows from the above that we do not think that revoking and reallocating the unpaired 2100 MHz spectrum would produce adverse effects which are disproportionate to achieving optimal use.

3.96 We have also given careful consideration to whether our proposals will have a particular impact on persons sharing protected characteristics (broadly including race, age, disability, sex, sexual orientation, gender reassignment, pregnancy and maternity, marriage and civil partnership, and religion or belief in the UK, and in Northern Ireland also dependents and political opinion), and in particular whether they may discriminate against such persons or impact on equality of opportunity or good relations. This assessment helps us comply with our duties under the Equality Act 2010 and the Northern Ireland Act 1998.[119] We do not consider that our proposals have equality implications under the 2010 Act or the 1998 Act.

3.97 Ofcom is required to take Welsh language considerations into account when formulating, reviewing or revising policies which are relevant to Wales (including proposals which are not targeted at Wales specifically but are of interest across the UK). We do not consider our proposals have any impact on opportunities for persons to use the Welsh language or treating the Welsh language no less favourably than the English language. We also do not think there are ways in which our proposal could be formulated so as to have, or increase, a positive impact, or not have adverse effects or decrease any adverse effects. This is because our proposals relate to a nationwide licensing regime.

Our decision

3.98 Overall, having considered all stakeholder responses, we conclude that regulatory intervention in the form of revocation of the unpaired 2100 MHz spectrum licences to enable reallocation of the spectrum to future users is appropriate and proportionate to meet our objective to secure optimal use of the spectrum, which will in turn secure the greatest benefits to consumers and citizens by enabling the introduction of new services using the spectrum.

3.99 We do not intend to apply annual licence fees for the unpaired 2100 MHz spectrum licences during the revocation notice period as we consider that the cost of setting fees is likely to be disproportionate to the fees that would be collected.

[119] Further detail is given in section 149 of the Equality Act 2010 and section 75 of the Northern Ireland Act 1998.

Next steps

3.100 We will shortly start the revocation process which will follow the legal requirements as set out in the Wireless Telegraphy Act (see Annex A1). As part of this process we will issue Notice of the proposed revocation to EE, VMO2 and H3G. We will consider any further representations that these licensees might want to make in response to our Notices of proposed revocation before making a final decision. Any licensee who receives a notice of revocation will have five years before it takes effect.

3.101 We will consult in due course on the future allocation of the unpaired 2100 MHz spectrum including allocation for rail. We will work with relevant stakeholders on an alternative spectrum solution for the ESN Gateway if necessary.

A1 Legal framework

Ofcom's licensing regime

A1.1 Under the Wireless Telegraphy Act 2006, and subject to some exceptions, it is unlawful to establish or use a wireless telegraphy station or to install or use wireless telegraphy apparatus, unless under and in accordance with a licence granted by Ofcom (also known as a "wireless telegraphy licence").[120] Ofcom has the power to grant a wireless telegraphy licence in relation to a particular station or particular apparatus or in relation to any station or apparatus described by the wireless telegraphy licence itself.[121]

A1.2 A wireless telegraphy licence may be granted by Ofcom subject to such terms, provisions, and limitations as Ofcom thinks fit.[122] In the case of a wireless telegraphy licence to establish a station, the limitation may in particular include limitations to position and nature of the station, the purpose for which the circumstances in which and the person by whom the station may be used and the apparatus that may be installed or used in the station.[123]

A1.3 In the case of other licences the limitations may, in particular, include limitations to the apparatus that may be installed or used and the places where, the purpose for which, the circumstances in which and the persons by whom the apparatus may be used.[124]

A1.4 Ofcom has the power to impose terms, provisions and limitations to the extent that it is satisfied that these are:[125]

- objectively justifiable in relation to the networks and services to which they relate;
- are not such to unduly discriminate against particular persons or a description of persons;
- proportionate to what we want to achieve; and
- transparent in relation to what they are intended to achieve.

A1.5 Further to the above, Ofcom's powers under the Wireless Telegraphy Act 2006 include the ability to revoke or vary any wireless telegraphy licence if:

- The terms and conditions of the licences do not curtail our ability to revoke and/or vary a wireless telegraphy licence; and
- The standards and procedures set out in Schedule 1 to the Wireless Telegraphy Act 2006 are followed (please see below for further details). [126]

A1.6 In particular, Ofcom has the power to vary and/or revoke a wireless telegraphy licence where it considers the variation or revocation to be objectively justifiable.[127]

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[120] Please refer to section 8 of the Wireless Telegraphy Act 2006.
[121] Please refer to section 9(5) of the Wireless Telegraphy Act 2006
[122] Please refer to section 9(1) of the Wireless Telegraphy Act 2006.
[123] Please refer to section 9(2) of the Wireless Telegraphy Act 2006.
[124] Please refer to section 9(3) of the Wireless Telegraphy Act 2006.
[125] Please refer to section 9(7) of the Wireless Telegraphy Act 2006.
[126] Please refer to section 10 of the Wireless Telegraphy Act 2006.
[127] Please refer to paragraph 6A of Schedule 1 of the Wireless Telegraphy Act 2006.

Legal framework for the grant, variation or revocation of a wireless telegraphy licence

A1.7 Schedule 1 to the Wireless Telegraphy Act sets out the framework for the grant, variation, and revocation of a wireless telegraphy licence.

A1.8 Where Ofcom is making provisions for the grant of a wireless telegraphy licence, on the application of a stakeholder, it must reach a decision:

- Within six weeks after the date of the receipt of the application, if the application relates to a frequency allocated in accordance with the United Kingdom Plan for Frequencies;[128] or
- As soon as possible in any other case, but in any event, within eight months.

A1.9 Ofcom has the power to vary or revoke a wireless telegraphy licence if the proposed revocation or variation is objectively justifiable.[129] Furthermore, Ofcom is under a duty to notify the person holding the licence of its proposal and:[130]

- state the reasons for the proposal; and
- provide the licensee with an opportunity to make representations about the proposal within a defined period, which (barring defined circumstances) cannot be shorter than 30 days beginning with the day after the one on which the notification was given to the licensee.[131]

A1.10 Once the consultation period is expired, Ofcom has one month to decide whether or not to revoke or vary the wireless telegraphy licence and give notification of such decision to the licensee within one month.[132] The decision can be taken in accordance with Ofcom's original proposal or can contain modifications in light of the representations received.[133] In any event, Ofcom's decision must be given no later than one week after it has been taken and state the reasons for the decision.[134]

A1.11 Further to the above, Ofcom's powers to revoke and/or vary a licence can be restricted by the terms of the licence in question.[135]

[128] Please refer to paragraph 2(1)(a) of Schedule 1 of the Wireless Telegraphy Act 2006.
[129] Please refer to paragraph 6A of Schedule 1 of the Wireless Telegraphy Act 2006.
[130] Please refer to paragraph 7 of Schedule 1 of the Wireless Telegraphy Act 2006.
[131] Please refer to paragraph 8 of Schedule 1 of the Wireless Telegraphy Act 2006.
[132] Please refer to paragraph 10 of Schedule 1 of the Wireless Telegraphy Act 2006.
[133] Please refer to paragraph 10(a) of Schedule 1 of the Wireless Telegraphy Act 2006.
[134] Please refer to paragraph 11 of Schedule 1 of the Wireless Telegraphy Act 2006.
[135] Please refer to paragraph 8 of Schedule 1 of the Wireless Telegraphy Act 2006.