5G COUNTRY PROFILE

UNITED KINGDOM

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Version 1.1

Note: Version 1.1 of this document is an advanced draft for possible additional inputs, comments, feedback. The final version of the document is planned to be released after the ITU Regional Forum for Europe.

1. ICT background and current status of broadband

The United Kingdom is one of the world's largest ICTs markets, with a highly advanced telecommunication sector characterized by its early liberalization and strong commercial competition. With affordable prices, the country has high penetration rates for fixed and mobile services. Particular in fixed broadband, the penetration is also very high and well above the European average. In the European region and beyond, the UK continues to be a champion of privatization in the telecommunication sector and elsewhere and its example greatly impacted the shaping of the EU policies on telecommunications. While national policies continue to prioritize the roll-out of high-speed broadband throughout the UK and the upgrades of networks, there are still rural areas that lack broadband. In the 2017 Global Development Index, the UK ranks 5th out of 176 countries.[1]

Building on a longstanding strategic approach to digital development, in March 2017, the UK government launched its UK Digital Strategy. The Strategy builds on the Culture White Paper[2] as well as the Industrial Strategy green paper,[3] and articulates its framework to the digital economy with particular regards to growth, technology, and innovation. The UK Digital Strategy sets out the Government's goals for digital infrastructure, creating an advanced skills base, encouraging the use of digital tools and improving access to digital services while addressing opportunities for businesses, research and development. Accordingly, the UK Digital Strategy's main seven strands are:

- Connectivity – building a world-class digital infrastructure for the UK;[4]
- Digital Skills and Inclusion – giving everyone access to the digital skills they need;[5]
- The Digital Sectors – making the UK the best place to start and grow a digital business;[6]
- The wider economy – helping every British business become a digital business;[7]
- A safe and secure cyberspace – making the UK the safest place in the world to live and work online;[8]
- Digital government – maintaining the UK government as a world leader in serving its citizens online;[9]
- Data – unlocking the power of data in the UK economy and improving public confidence in its use.[10]

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[1] See: https://www.itu.int/net4/ITU-D/idi/2017/index.html

[2] See: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/510798/DCMS_The_Culture_White_Paper__3_.pdf

[3] See: https://beisgovuk.citizenspace.com/strategy/industrial-strategy/supporting_documents/buildingourindustrialstrategygreenpaper.pdf

[4] See: https://www.gov.uk/government/publications/uk-digital-strategy/1-connectivity-building-world-class-digital-infrastructure-for-the-uk

[5] See: https://www.gov.uk/government/publications/uk-digital-strategy/2-digital-skills-and-inclusion-giving-everyone-access-to-the-digital-skills-they-need

[6] See: https://www.gov.uk/government/publications/uk-digital-strategy/3-the-digital-sectors-making-the-uk-the-best-place-to-start-and-grow-a-digital-business

[7] See: https://www.gov.uk/government/publications/uk-digital-strategy/4-the-wider-economy-helping-every-british-business-become-a-digital-business

[8] See: https://www.gov.uk/government/publications/uk-digital-strategy/5-a-safe-and-secure-cyberspace-making-the-uk-the-safest-place-in-the-world-to-live-and-work-online

[9] See: https://www.gov.uk/government/publications/uk-digital-strategy/6-digital-government-maintaining-the-uk-government-as-a-world-leader-in-serving-its-citizens-online

[10] See: https://www.gov.uk/government/publications/uk-digital-strategy/7-data-unlocking-the-power-of-data-in-the-uk-economy-and-improving-public-confidence-in-its-use

Based on the legislation as well as rules imposed by the regulator, every home and business in the UK has the legal right to request a decent, affordable broadband connection.[11] Moreover, some of the UK government's targets set in the strategy are consistent with the European Commission's Digital Agenda for Europe (DAE).

Furthermore, it is worth mentioning that the UK Government has achieved its aim of providing 95% coverage with 24 Mbps by the end of 2017[12]. The Government has set a target to achieve nationwide gigabit connectivity as soon as possible, with an ambition to achieve this by 2025.[13]

In addition to the fixed-services expansion, the UK government signed on the Shared Rural Network (SRN) in March 2020. This project is a public-private investment partnership to transform mobile broadband coverage in rural areas without duplicating infrastructure. Led by UK's four MNOs—EE, Telefónica UK (O2), Three and Vodafone— through a jointly owned company called Digital Mobile Spectrum, SRN determines the following:[14]

- Each MNO shall reach 88 per cent coverage of the UK by 2024;
- Each MNO shall reach 90 per cent coverage of the UK by 2026;
- Each MNO shall reach nation-specific coverage targets in England, Northern Ireland, Scotland, and Wales by 2026; and
- Collectively, the MNOs shall provide additional coverage to 280,000 premises and 16,000km of roads by 2026.

To accomplish these targets, Ofcom has developed legally enforceable coverage obligations that are attached to the mobile network operators' radio spectrum licences. Together this means all four mobile network operators will deliver 95% combined 4G coverage across the whole of the UK landmass[15] by the end of 2025.[16]

Other broadband-related government-led policies that are worth mentioning in the UK context include the Welsh Government Superfast Cymru: a project to deliver superfast broadband access of at least 30 Mbps to nearly 700,000 premises;[17] the Scottish Government's commitment to extending superfast broadband access to 100% of premises across Scotland by 2021;[18] the UK's ICT and digital services strategy for 2020-2025 period, which deals with the government's engagement with private stakeholders to

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[11] See: https://www.ofcom.org.uk/phones-telecoms-and-internet/advice-for-consumers/broadband-uso-need-to-know
[12] See: https://ec.europa.eu/digital-single-market/en/country-information-united-kingdom#:~:text=Main%20aims%20for%20broadband%20development,of%20the%20population%20by%202027.
[13] See: Conservative Party Manifesto, 2019
[14] See: https://www.gov.uk/government/news/shared-rural-network
[15] See: https://www.techuk.org/insights/news/item/18040-government-announces-new-digital-strategy
[16] See: https://www.gov.uk/government/news/shared-rural-network
[17] See: https://beta.gov.wales/superfast-broadband
[18] See: https://www.gov.scot/publications/realising-scotlands-full-potential-digital-world-digital-strategy-scotland/

achieve the United Nation's Sustainable Development Goals and meet the government's net-zero commitments;[19] the Digital Northern Ireland 2020 (DNI);[20] and others.

Amid the socioeconomic challenges that resulted from the COVID-19 pandemic, the local press has reported that the UK government is currently working on a new digital strategy[21] with a focus on I) Securing an adequacy agreement with the European Union; II) creating a highly-skilled digital workforce; III) building a world-class next-generation infrastructure; and IV) ensuring a regulatory regime that is pro-competition and pro-innovation.[22]

2. Broadband and mobile telecommunication sectors data

ITU data shows that 92.52% of individuals had access to the Internet in 2019 in the United Kingdom.[23] In 2010, the ITU data for the country was 85% and, in 2000, 26.82%. In 2018, the number of fixed-broadband subscriptions per 100 inhabitants was 39.60.[24] Data from the UK's Office for National Statistic show that fixed-broadband has continued to be the most popular type of household Internet connection since first measured in 2015, with 98% of households with internet access having this type of connection in 2019.[25] While Asymmetric Digital Subscriber (ADSL) 1 and ADSL2+ are available throughout the country, cable and fibre-to-the-cabinet (FTTC) as well as fibre-to-the-premises (FTTP) are becoming increasingly available and offered by several Internet Service Providers (ISP), with FTTP now representing the most common fibre connection in the UK.[26] Throughout the country, London and South East were the UK regions with the highest internet use in 2019, while Northern Ireland remained the lowest.[27] Despite that, Northern Ireland has the highest full-fibre coverage of any UK nation, with nearly a third of homes able to receive it. Wales was also above the UK average, with 12% coverage.[28] In terms of fibre connections throughout its territory, only around 10% of UK homes received full-fibre broadband, offering download speeds of up to 1 Gbps as of September 2019.[29]

In its 2019 report, the Office of Communications (Ofcom), the regulatory authority in the UK, reported that data use on fixed lines increased to an average of 315GB per connection per month, from 240GB in 2018.

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[19] See: https://www.gov.uk/government/publications/greening-government-ict-and-digital-services-strategy-2020-2025
[20] See: https://joinup.ec.europa.eu/sites/default/files/inline-files/Digital_Government_Factsheets_UK_2019.pdf
[21] See: https://tech.newstatesman.com/policy/uk-digital-strategy-2020
[22] See: https://www.techuk.org/insights/news/item/18040-government-announces-new-digital-strategy
[23] See: ITU World Telecommunication/ICT Indicators Database online (2020): http://handle.itu.int/11.1002/pub/81550f97-en (indicator "i99H")
[24] See: ITU World Telecommunication/ICT Indicators Database online (2020): http://handle.itu.int/11.1002/pub/81550f97-en (indicator "i992b")
[25] See: https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/bulletins/internetaccesshouseholdsandindividuals/2019
[26] See: https://www.ofcom.org.uk/phones-telecoms-and-internet/advice-for-consumers/advice/broadband-speeds/broadband-basics https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/bulletins/internetaccesshouseholdsandindividuals/2019
[27] See: https://www.ons.gov.uk/businessindustryandtrade/itandinternetindustry/bulletins/internetusers/2019
[28] See: https://www.ofcom.org.uk/about-ofcom/latest/media/media-releases/2019/latest-uk-broadband-mobile-coverage-revealed
[29] See: https://www.ofcom.org.uk/about-ofcom/latest/media/media-releases/2019/latest-uk-broadband-mobile-coverage-revealed

In its 2020 Summer update, Ofcom reported that 14% homes in the UK had full-fibre broadband connectivity, offering download speeds of up to 1 Gbps, showing an increase in fibre connectivity of at least 2.2 million additional homes in comparison to the previous year.[30] Additionally, 57% of UK homes were able to get ultrafast broadband (300 Mbps).

Whilst household internet access has risen over the last decade, it has been levelling off in recent years.[31] From the regional perspective, Europe's average fixed-broadband basket cost was 1.5 per cent of the GNI per capita in 2019, while the United Kingdom's corresponded to 1.3 per cent for an unlimited data package per month in 2019.[32]

In 2018, the number of active mobile-cellular subscriptions per 100 inhabitants was of 118.37.[33] Moreover, the number of active-mobile broadband subscriptions per 100 inhabitants was 98.54 in the same year.[34] In terms of In addition to a few mobile virtual network operators (MVNO), there are four major mobile network operators (MNOs) that dominate the market in the United Kingdom: Vodafone, 3 UK (H3G), Telefónica O2, and EE (acquired by BT).[35] Both 3G and 4G mobile networks were available to 99.7% of the population in 2018.[36] In terms of geographic coverage, data from the regulator reveals that 67% of the UK's land area is covered by 4G by the four major MNOs in the country, while 91% of the country can get reliable 4G from at least one operator.[37] However, challenges concerning mobile broadband coverage in rural areas remain a relevant issue as only 63% of rural areas received coverage from all four major operators, while 5% of the UK's landmass gets no mobile voice and text reception at all.[38] The country's mobile-data basket cost corresponded to 0.6 per cent of the GNI per capita in 2019 for a monthly allowance of 5 Gb, while the European region's average was 0.8 per cent in 2019.[39]

3.   Current progress on 5G: consultations and national strategies

In October 2015, the Chancellor of the Exchequer announced the creation of a National Infrastructure Commission (NIC), to be commissioned to provide a clear picture of the future infrastructure that the UK needs to prioritize.[40] As early as 2016, NIC published a final report on 5G with a set of recommendations on metrics for the networked development. The report also included a call for Ofcom and the government to review the then-existing regulatory regime regarding spectrum and obligations to ensure that it

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[30] https://www.ofcom.org.uk/research-and-data/multi-sector-research/infrastructure-research/connected-nations-update-summer-2020/interactive-report
[31] See: https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/bulletins/internetaccesshouseholdsandindividuals/2019
[32] See: https://www.itu.int/en/ITU-D/Statistics/Documents/publications/prices2019/ITU_ICTpriceTrends_2019.pdf
[33] See: https://www.itu.int/en/ITU-D/Statistics/Documents/statistics/2019/Mobile_cellular_2000-2018_Dec2019.xls
[34] See: ITU World Telecommunication/ICT Indicators Database online (2020): http://handle.itu.int/11.1002/pub/81550f97-en (indicator "i911mw")
[35] See: https://www.spectrummonitoring.com/frequencies/#UK
[36] See: ITU World Telecommunication/ICT Indicators Database online (2020): http://handle.itu.int/11.1002/pub/81550f97-en (indicators "i271G" and "i271GA")
[37] See: https://www.ofcom.org.uk/research-and-data/multi-sector-research/infrastructure-research/connected-nations-update-summer-2020
[38] See: https://www.ofcom.org.uk/research-and-data/multi-sector-research/infrastructure-research/connected-nations-update-summer-2020
[39] See: https://www.itu.int/en/ITU-D/Statistics/Documents/publications/prices2019/ITU_ICTpriceTrends_2019.pdf
[40] See: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/597421/07.03.17_5G_strategy_-_for_publication.pdf

supports the sharing of telecoms infrastructure for the 5G roll-out. NIC has called for local authorities and Local Enterprise Partnerships (LEPs) to work with network providers to develop approaches that enable the deployment of the tens of thousands of small cells in urban centres.[41]

Also, in 2016, the UK government announced its National Productivity Investment Fund (NPIF) worth in total of 25.3 billion EUR, of which 815.6 million EUR funded by the government were allocated to 5G trials and full-fibre deployment across the UK by 2020-2021.

In January 2017, a report from the Future Communications Challenge Group (FCCG) has identified three policy areas that could enhance the 5G deployment phase in the UK: I) Facilitating operators' ability to deploy network equipment; II) Ensuring the industry has sufficient spectrum; and Ensuring application of net neutrality rules is compatible with 5G use cases.[42]

In March 2017, the Department for Digital Culture, Media and Sport (DCMS) has released a policy paper entitled "Next-Generation Mobile Technologies: A 5G strategy for the UK."[43] This strategy sets out the government's ambition that the UK should be a global leader in 5G so that we can take early advantage of its potential and help to create a world-leading digital economy that works for everyone. The strategy outlines the key themes and a set of specific measures to determine the UK's progress towards 5G, which are:[44]
- building the economic case;
- fit for purpose regulations;
- local areas – governance and capability;
- coverage and capacity – convergence and the road to 5G;
- ensuring a safe and secure deployment of 5G;
- spectrum; and
- technology and standards.

In terms of investment, the strategy details the government's plan to initially invest aroundUSD19.5 million) on a 'cutting edge' facility equipped with appropriate technology to run the trials in partnership with industry working at the forefront of 5G.[45] The strategy outlines DCMS' collaboration with Ofcom in identifying and tackling unnecessary barriers to infrastructure sharing and will explore the potential for a clearer and more robust framework to allow companies to share infrastructure while preserving investment incentives.

After building upon a series of documents regarding 5G in the country, the UK government has announced, in July 2018, its main target on providing the majority of the population with 5G signal by

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[41] See: https://www.gov.uk/government/news/government-must-take-action-now-to-secure-our-connected-future-so-we-are-ready-for-5g-and-essential-services-are-genuinely-available-where-they-are-n
[42] See: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/582640/FCCG_Interim_Report.pdf
[43] See: https://www.gov.uk/government/publications/next-generation-mobile-technologies-a-5g-strategy-for-the-uk
[44] See: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/597421/07.03.17_5G_strategy_-_for_publication.pdf
[45] See: https://www.commsbusiness.co.uk/features/uk-5g-strategy-update/

2027. The Government's strategy for future digital infrastructure—full-fibre and 5G—is set out in DCMS's Future Telecoms Infrastructure Review (FTIR). FTIR focuses on supporting a "market expansion model" for 5G in the UK.[46] The FTIR identified four priority areas that Government policy for 5G will focus on to support the market expansion model:[24]

- Make it easier and cheaper to deploy mobile infrastructure and support market expansion, including the implementation of the wide-ranging Electronic Communications Code (ECC) on-site access and consideration of further planning reforms;
- Support the growth of infrastructure models that promote competition and investment in network densification and extension;
- Fund beneficial use cases through the Government's 220.5 million EUR 5G Testbeds and Trials Programme that helps de-risk business models for 5G; and
- Promote new, innovative 5G services from existing and new players, through the release of additional spectrum. We should consider whether more flexible, shared spectrum models can maintain network competition between MNOs while also increasing access to spectrum to support new investment models, spurring innovation in the industrial IoT, wireless automation and robotics, and improving rural coverage.

In November 2018, Ofcom launched a report entitled "Enabling 5G in the UK," providing further information on the regulator's work to guarantee the early 5G roll out in the country within the framework of the 2017 strategy and previous public consultations. The report provides an overview of the actions taken by Ofcom to enable the 5G development in the UK:[47]
- making spectrum available for 5G and other wireless services;
- working with Government and policymakers to ensure access to sites is not a barrier to 5G;
- ensuring access to appropriate connectivity between 5G base stations and the core network (backhaul);
- ensuring net neutrality regulation is not a barrier to deployment; and
- acting as a facilitator, working with Government, different industry sectors and other countries to further understand potential applications of 5G.

In November 2018, the UK Government published the "National Infrastructure and Construction Pipeline" report, which givens an overview of public and private investments that are underway or expected to be put toward 5G and full-fibre (FTTP) between 2018/19 and 2020/21 (financial years). The document specifies that 7.5 billion EUR should be devoted to full-fibre and 5G upgrades by 2021.[48]

Following previous 5G-related investments by the government, the UK's Department for Digital, Culture, Media & Sports (DCMS) announced a 64 million GPB (70 million EUR) funding package for 5G trials in

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[46] See:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/732496/Future_Telecoms_Infrastructure_Review.pdf

[47] See: https://www.ofcom.org.uk/__data/assets/pdf_file/0022/111883/enabling-5g-uk.pdf

[48] See: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/759222/CCS207_CCS1118987248-001_National_Infrastructure_and_Construction_Pipeline_2018_Accessible.pdf

February 2020. DCMS also announced that the funding package shall benefit residents of rural areas.[49] The package can be broken down into:[50]

- 33.1 million EUR for the Rural Connected Communities (RCC) competition for seven 5G research and development projects across the UK. This includes five in England, one in Wales and one in Scotland with plans to expand into Northern Ireland. Test sites will be set up in Yorkshire, Gwent, Monmouthshire, Orkney, Wiltshire, Nottinghamshire, Dorset, Shropshire and Worcestershire;
- More than 5.5 million EUR of funding will be awarded to two industrial projects, led by Ford Motor Company and Zeetta Networks, to test the benefits of using 5G to boost productivity in the manufacturing sector;
- A new 33.1 million EUR to open competition—"5G Create"—has been launched to develop new uses for 5G in a variety of industries, including our creative sectors such as film, TV and video games. From enabling remote production to supporting the expansion of the increasingly popular world of esports, 5G has the potential to revolutionise the UK's booming creative industries. Six projects have already been selected across the UK with more to be announced soon.

Additionally, many other public consultations covering issues of the spectrum allocation, rules on the auction for the 700MHz and 26 GHz bands, as well as rural mobile coverage and EMF have been launched by the regulator between 2019 and 2020,[51] all of which have been considered by the account for the auctions and 5G rollout rules in the UK. [52]

4. Spectrum assignment for 5G & market development

In September 2017, Ofcom publish a report outlining its preparations for the release of spectrum suitable for future mobile services.[53] The regulator also mentioned that it supports the Radio Spectrum Policy Group's (RSPG's) identification of 26GHz as a 'pioneer band' for 5G in Europe.[54]

In April 2018, Ofcom concluded the first auction of 5G spectrum by selling 150 MHz of 3.4GHz spectrum previously used by the Ministry of Defence, with all four MNOs securing spectrum for 10 years.[55] The auction had two bidding stages—principal and assignment stages—using a format known as simultaneous multiple round ascending (SMRA), generating the following licensing results:[56]

- Airspan Spectrum Holdings Limited has not won spectrum in either band;
- EE Limited has won 40 MHz of 3.4 GHz spectrum at a cost of 335.2 million EUR;

[49] See: https://www.gov.uk/government/news/new-65-million-package-for-5g-trials
[50] See: https://www.gov.uk/government/news/new-65-million-package-for-5g-trials
[51] See: https://www.ofcom.org.uk/__data/assets/pdf_file/0032/198770/ofcom-annual-report-and-accounts-2019-20.pdf
[52] See: https://5gobservatory.eu/public-initiatives/national-5g-plans-and-strategies/#1533566348807-66cd9716-c6d2
[53] See: https://www.ofcom.org.uk/__data/assets/pdf_file/0021/97023/5G-update-08022017.pdf
[54] See: https://www.telegeography.com/products/commsupdate/articles/2017/02/09/ofcom-updates-5g-spectrum-plans
[55] See: https://5gobservatory.eu/5g-spectrum/national-5g-spectrum-assignment/#1533313745961-d2a5cc14-241a
[56] See: https://www.ofcom.org.uk/about-ofcom/latest/features-and-news/results-auction-mobile-airwaves

- Hutchison 3G UK Limited has won 20 MHz of 3.4 GHz spectrum at a cost of 167.6 million EUR;
- Telefónica UK / O2 has won all 40 MHz of 2.3 GHz spectrum available, at a cost of 228.1 million EUR; and 40 MHz of 3.4 GHz spectrum at a cost of 352.1 million EUR; and
- Vodafone UK has won 50 MHz of 3.4 GHz spectrum at a cost of 419 million EUR.

As reflected above, Ofcom also auctioned off 40MHz of 2.3GHz spectrum for immediate use to provide additional capacity for 4G networks, which can also be used for 5G in the future. When compared to the 4G spectrum auction that took place in 2013, the 2018 auction generated a financial amount that is equivalent to roughly three-quarters of the spectrum previously auctioned.[57]

On 9 March 2020, the UK Government announced that it had agreed a deal with the four mobile operators to deliver the Shared Rural Network, which will see operators collectively increase mobile phone coverage throughout the UK to 95% by the end of 2025, underpinned by legally binding coverage commitments . Compliance with these obligations will be assessed by Ofcom in 2024, by when each operator has committed to have reached 88% geographic coverage of the UK, and 2026 when each operator has committed to have reached at least 90% geographic coverage of the UK. Each operator has also agreed to meet coverage thresholds in each UK nation, again to be assessed in 2024 and 2026, alongside collectively providing new roads and premises coverage. Progress towards these outcomes will be published in the regular Ofcom Connected Nations reports.

In July 2018, Ofcom opened up a consultation on 57-71 GHz frequencies. On this occasion, the regulator decided to change the authorization approach for fixed wireless systems in the 64-66 GHz band to license-exempt and to implement common technical conditions across the 57-71 GHz band for short-range wideband data transmission systems and fixed wireless systems.[58] Furthermore, Ofcom has been working to free up the 168MHz of the spectrum between 7.9GHz and 8.4GHz, and 2.25GHz of the spectrum between 24.25GHz and 26.5GHz.[59] It plans to make the 1492-1517MHz band available for future wireless broadband services by December 2022. Moreover, Ofcom is also considering the 37-43.5 and 66-71GHz bands, and potentially also the 32GHz (31.8 – 33.4GHz) band.[60]

In June 2019, Ofcom issued a public consultation on defragmentation of 3.4-3.8 GHz frequencies. As a result, the regulator plans to introduce spectrum sharing and open up spectrum (3800-4200/1800/2300 MHz) to private network operators and vertical industry players on a first-come-first-serve basis. Spectrum sharing will also be introduced in the 26 GHz frequencies, but only for indoor services. In July 2019, Ofcom published a document "Draft UK Interface Requirement (IR) 2105," defining the technical conditions for "Shared Access Indoor 26 GHz".[61]

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[57] See: https://5g.co.uk/guides/5g-uk-auction/
[58] See: https://www.ofcom.org.uk/__data/assets/pdf_file/0016/115630/Implementing-decisions-5771-GHz-band.pdf
[59] See: https://5g.co.uk/news/ofcom-additional-spectrum-5g/4922/
[60] See: https://5g.co.uk/guides/5g-uk-auction/
[61] See: https://www.ofcom.org.uk/__data/assets/pdf_file/0031/158278/draft-ir-2105-shared-access-26-ghz-indoors.pdf

In November 2019, Ofcom has issued a consultation on draft statutory instruments that would support its local spectrum access and spectrum sharing policies.

In March 2020, Ofcom announced the rules that will apply for its forthcoming auction of 5G-suitable spectrum. According to the regulator's rules, the spectrum would be made available for bids in the following lots:[62]

- Six lots of 2x5 MHz (60 MHz in total) in the 700 MHz band with a reserve price of 110.8 million EUR per lot;
- Four lots of 5 MHz (20 MHz in total) of 700 MHz downlink-only spectrum, with a reserve price of 1.1 million EUR per lot; and
- 24 lots of 5 MHz (120 MHz in total) of 3.6-3.8 GHz spectrum, with a reserve price of 22.2 million EUR per lot.

Regarding the obligations, Ofcom confirmed it does not plan to any longer include coverage obligations, and that the two spectrum lots that carried a proposed maximum will no longer apply.[63] The regulator has also Ofcom has imposed a 37% cap on overall spectrum holdings. As a result, EE will be allowed to obtain a maximum of 120 MHz, while Three and Vodafone will be able to secure up to 185 MHz and 190 MHz respectively. Due to its current spectrum holdings, O2 will not be restricted by the cap.[64]

Private stakeholders have also requested Ofcom to move to a more flexible approach to licensing for 5G spectrum to allow spectrum that is not being used by the major MNOs to be used by other parties, for example in rural areas.[65]

In August 2020, as a result of the COVID-19 pandemic, Ofcom postponed its plans to auction the 700MHz and 3.6GHz-3.8GHz bands to January 2021.[66]

5. Electromagnetic fields levels and the implementation dynamics

The UK Government mandates that that EMF emissions should comply with the ICNIRP Guidelines. More specifically, the UK's policy on EMF limits is set out in the Written Ministerial Statement of 2009, though it stems from the advice given by the National Radiological Protection Board (NRPB) in 2004.[67] This policy details the national compliance with the 1998 ICNIRP exposure guidelines[68] in the terms of the 1999 EU Recommendation, and a precautionary policy called "optimal phasing."[69] All the practical details needed to apply the policy of compliance with exposure limits as well as the optical phasing are contained in a Code of Practice.[70] It is the Public Health England (PHE), an executive agency to the Department of Health and Social Care, that is at the forefront of public health matters associated with radiofrequency

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[62] See: https://www.ofcom.org.uk/about-ofcom/latest/media/media-releases/2020/plans-for-spectrum-auction
[63] See: https://www.ofcom.org.uk/about-ofcom/latest/media/media-releases/2020/mobile-airwaves-auction
[64] See: https://www.rcrwireless.com/20200804/5g/uk-regulator-award-additional-5g-spectrum-january-2021
[65] See: https://commonslibrary.parliament.uk/research-briefings/cbp-7883/
[66] See: https://www.ofcom.org.uk/__data/assets/pdf_file/0012/200901/melanie-dawes-to-mnos.pdf
[67] See: http://www.emfs.info/wp-content/uploads/2014/07/DHletterandannex2004.pdf
[68] See: https://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf
[69] See: http://www.emfs.info/policy/sage/1ia-govt/
[70] See: http://www.emfs.info/wp-content/uploads/2014/07/PowerlinesDemonstratingcomplianceVCoP2012resaved.pdf

electromagnetic fields in the UK.[71]All manufacturers, installers and operators of radio equipment should therefore already consider the recommendations by PHE and Ofcom when manufacturing, installing or operating equipment.[72]

While the UK's Mobile Telecommunications and Health Research Programme (MTHR) ended in 2012, the UK government has been funding research on the effects on the health of a range of EMF and mobile technologies mainly through the Department of Health and Social Care's National Institute for Health Research (NIHR) and Public Health England (PHE). Recent projects have considered airwave health monitoring, the study of mobile phone use on health,[73] study on mobile phones and adolescents and cognition at Imperial College London,[74] as well as other initiatives by PHE's research initiatives, including its Advisory Group on Non-Ionising Radiation (AGNIR), which came to an end in 2017.[75]

Although Ofcom is not responsible for setting the EMF safety levels in the UK, it has been testing the EMF levels near to mobile phone base stations for many years. Ofcom's published measurements have consistently shown that EMF levels are well within the internationally agreed levels published in the ICNIRP Guidelines.[76] In February 2020, Ofcom published a consultation which proposes to include a specific condition in Wireless Telegraphy Act licences requiring licensees (including mobile operators and other radio users) to comply with the ICNIRP Guidelines.[77]

Concerning 5G development, the PHE has been providing the public with information on reviews, guideless and policies while acknowledging that fewer studies have been conducted at the mm-wave frequencies that are planned for use by 5G than at lower frequencies. In recent measurements near 5G-enabled base stations, Ofcom has recorded measurements well within the levels for general public exposure from the ICNIRP Guidelines. In fact, the highest level measured was approximately 1.5% of the levels identified in the ICNIRP Guidelines.[78]

In April 2020, within the context of growing civic pressure concerning conspiracy theories around 5G to the global COVID-19 pandemic, Ofcom released a brochure claiming that there is no scientific basis or credible evidence regarding a causal relationship between the two.[79] Currently, PHE information about EMF exposures is available on the unified UK Government website.[80] The material about base stations has been updated to mention recent technology developments, such as 5G, and the latest national and international health evidence reviews. PHE continues to deliver expert review reports on non-ionising radiation topics as and when sufficient new evidence has accumulated. [81]

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[71] See: https://www.gov.uk/government/publications/5g-technologies-radio-waves-and-health
[72] See: https://www.ofcom.org.uk/__data/assets/pdf_file/0013/190003/emf-condoc.pdf
[73] See: http://www.thecosmosproject.org/
[74] See: https://www.scampstudy.org/
[75] See: https://www.who.int/peh-emf/project/mapnatreps/uk_2019.pdf?ua=1
[76] See: https://www.ofcom.org.uk/spectrum/information/mobile-operational-enquiries/mobile-base-station-audits
[77] See: https://www.ofcom.org.uk/consultations-and-statements/category-1/limiting-exposure-to-emf
[78] See: https://www.ofcom.org.uk/__data/assets/pdf_file/0013/190003/emf-condoc.pdf
[79] https://www.ofcom.org.uk/__data/assets/pdf_file/0015/202065/5g-guide.pdf
[80] See: https://www.gov.uk/government/groups/advisory-group-on-non-ionising-radiation-agnir
[81] See: https://www.gov.uk/government/groups/advisory-group-on-non-ionising-radiation-agnir

On 24 September 2020, PHE updated it's guidance on mobile phone base stations, and how exposures are measured. This information can be found on gov.uk. Following a consultation earlier in the year, Ofcom announced on 5 October 2020 that it intends to include a specific condition in the licences of mobile phone companies, TV and radio broadcasters requiring licensees to comply with the limits on EMF exposure proposed by ICNIRP (the International Commission on Non-Ionising Radiation Protection[82]).

Finally, Ofcom is making available a trial version of an EMF calculator[83] that will allow many licensees and other spectrum users to demonstrate their compliance in a straightforward way. Ofcom also recently opened a further consultation on EMF by private stakeholders.[84]

6. 5G commercial launches: announcements, trail cities, and digital cross-border corridors

Since 2015, private stakeholders have been engaging with Ofcom on matters related to the commercialization of 5G, providing comments on high-frequency bands and other regulatory measures.[85] Additionally. during the same year, the University of Surrey announced that its 5G Innovation Centre (5GIC) has achieved data speeds of 1 Tbps over a distance of 100 meters in lab tests using university-built equipment.[86] Other tests and partnership between operators and equipment providers also occurred during the same year. For instance, EE, in partnership with Alcatel-Lucent, achieved download speeds of more than 5Gbps using "XG.FAST" in 35 metres cable and 1.8 Gbps over 100 metres over copper lines.[87]

In August 2016, EE announced a research collaboration agreement on 5G with Nokia. The agreement details the companies' plans to work together on potential customer use cases for 5G technologies, the creation of 5G Proof of Concept (PoC) trials and the development of the emerging technology standards and equipment. Local press reported that Nokia and BT conducted trials at the operator's lab in Suffolk using Nokia's AirScale radio access.[88]

In February 2017, telecom infrastructure company Arqiva announced plans for 5G trials in the UK in partnership with Samsung. The 5G trials included testing 5G fixed-wireless access (FWA) technology in highly urbanized areas such as downtown London. The trials utilized Samsung's 5G network solution and Customer Premises Equipment (CPE) and using Arqiva's 28GHz millimetre wave (mmWave) spectrum.[89] After four months, the companies announced that they established a stable two-way mmWave link with downlink speeds of around 1Gbps through CPE.[90]

In February 2017, Vodafone, Ericsson and Qualcomm Technologies announced a new collaboration focused on 5G New Radio (NR) trial based on the 5G NR specifications. The trial utilized advanced 3GPP 5G NR technologies including Massive Multiple-Input Multiple-Output (MIMO) antenna technology,

[82] See: https://www.ofcom.org.uk/consultations-and-statements/category-1/limiting-exposure-to-emf
[83] See: https://www.ofcom.org.uk/__data/assets/file/0022/204529/emf-calculator-v0.1.1.xlsx
[84] See: https://www.ofcom.org.uk/consultations-and-statements/category-1/limiting-exposure-to-emf
[85] See: https://www.commsupdate.com/articles/2015/01/19/ofcom-invites-comments-on-high-frequency-bands-for-5g/
[86] See: https://www.bbc.com/news/technology-31622297
[87] See: https://www.thefastmode.com/technology-solutions/6338-bt-pushes-broadband-speeds-to-5-6gbps-with-xg-fast-over-copper-lines
[88] See: http://www.lteto5g.com/bt-nokia-ink-research-collaboration-agreement-5g-technologies/
[89] See: https://news.samsung.com/global/arqiva-and-samsung-kick-off-uks-first-5g-fixed-wireless-access-trial
[90] See: https://5g.co.uk/news/samsung-and-arqiva-5g-fwa-trial-live/4190/

adaptive self-contained TDD, beamforming techniques, scalable OFDM-based waveforms to support wider bandwidths, advanced coding and modulation schemes, and a new flexible framework design.[91]

In March 2018, O2 UK announced the construction of 5G tests beds at the O2 arena in North Greenwich, the first venue to launch a live 4G trial in London in 2011. The operator informed the public that its 5G testbed will rely on a Multi-access Edge Computing (MEC) solution and will be configured for the virtualisation of core 5G network technologies.[92]

In April 2018, Vodafone, after securing a 50MHz block of spectrum in the 3.4GHz band in April, announced that it became the first UK's MNO to complete a test of 5G spectrum across an existing live network (LTE/4G). The operator claimed it used 3.4GHz frequencies on its network between Manchester and its headquarters in Newbury, Berkshire. To carry out the 5G spectrum test, the g used a site at its Manchester contact centre which houses around 1,000 customer service employees, and its offices in Newbury, with the test utilising Massive MIMO technology combined with 3.4GHz spectrum running over the operator's core 4G network.[93] In June 2018, Vodafone announced that the 7 initial "5G Tral Cities"—Birmingham, Bristol, Cardiff, Glasgow, Liverpool, London and Manchester.[94] In October 2018, Vodafone UK announced, for the first time, that it was able to stream live 5G mobile data a site in Salford, Manchester.[95]

In September 2018, DCMS announced West Midlands as the first's large-scale 5G testbed in the UK.

In October 2018, in preparation for a full commercial 5G launch, EE has switched on the UK's first 5G trial network in London's Canary Wharf.[96] In November 2018, EE announced new 5G trial sites across East London: Provost Street, City Road, Central Street, Old Street, Cheapside, St Paul's, Finsbury Circus Garden, Clerkenwell Street and Bartholomew Square.[97] The operator launched its commercial 5G network in May 2019. Moreover, EE claims to have extended the reach of its next-generation mobile broadband connectivity to a total of 112 towns and cities across the country by October 2020. Meanwhile, the EE claims that in the last twelve months it has more than doubled the amount of 5G sites in what it refers to as 'key cities', such as Belfast, Birmingham, Cardiff and Edinburgh.[98]

In November 2018, Three UK announced investments of more than 2.2 billion EUR[99] on network infrastructure as preparation for the launch of 5G.[100] To upgrade its network, the operator announced that it acquired the country's 'leading 5G spectrum portfolio'; signed an agreement for the rollout of new cell site technology to prepare major urban areas for the rollout of 5G devices; built a super high-capacity dark fibre network, which connects 20 new data centres; deployed a 5G-ready, fully integrated cloud-

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[91] See: https://www.ericsson.com/en/news/2017/2/ericsson-qualcomm-and-vodafone-trial-5g-new-radio-for-unified-5g
[92] See: https://news.o2.co.uk/press-release/o2-launch-5g-test-bed-o2/
[93] See: https://newscentre.vodafone.co.uk/press-release/first-test-new-5g-spectrum-across-live-network/
[94] See: https://newscentre.vodafone.co.uk/press-release/5g-trial-seven-cities/
[95] See: https://www.landmobile.co.uk/news/vodafone-5g-trial-salford/
[96] See: https://www.mirror.co.uk/tech/ee-launches-first-5g-network-13368492
[97] See: https://newsroom.ee.co.uk/ee-switches-on-5g-trial-sites-in-east-london/
[98] See: https://www.commsupdate.com/articles/2020/10/14/ee-extends-5g-coverage-to-twelve-more-locations/
[99] See: https://www.mobileworldlive.com/featured-content/top-three/3uk-set-for-2b-5g-investment
[100] See: https://www.zdnet.com/article/three-uk-to-invest-over-2bn-in-new-5g-infrastructure/

native core network in the new data centres, which at launch will have an initial capacity of 1.2TBps; and rolled out carrier aggregation (CA) technology at 2,500 sites in the 'busiest' areas.[101] Beyond London, the company announced 16 additional cities, including UK's three other capitals: Cardiff, Edinburgh, and Belfast.[102]

In February 2019, Vodafone UK has announced the switch-on of a 5G hotspot at Manchester Airport using massive MIMO technology. Given that 5G handsets are not yet available for consumers, the operators used its Gigacube device—a portable router that is 5G-enabled. As such, the trial has seen consumers connect to 5G via the Gigacube and use a free 'Entertainment Pass' for streaming video service NOW TV to download and stream content.[103] In other 5G tests occurring at the same time, local press reported that Vodafone was using 5G smartphones form factor connected to Qualcomm Snapdragon X50 5G modems and antenna modules with integrated RF (radio frequency) transceiver, RF front-end and antenna elements.[104]

In June 2019, O2 UK announced it initiated 5G tests at the Millbrook Testing Ground for self-driving cars in Bedfordshire using the 2.3GHz and 3.4GHz spectrum.[105] According to O2, the on-site network at Millbrook consists of 59 cell sites and 89 small cells and is operated by British wireless solution provider Dense Air. Under a twelve-month agreement with the AutoAir project, O2 will integrate the sites and small cells into its public infrastructure.[106]

In July 2019, Vodafone UK switched on its 5G network for both residential and business customers for about the same price, with initial coverage of seven cities--Birmingham, Bristol, Cardiff, Glasgow, Manchester, Liverpool and London. The operator also announced that choices for 5G smartphones during the summer of 2019. Moreover, it also announced the launch of a 5G router for use in the home and office to give customers without a fixed-line connection high-speed broadband access.[107] A few weeks later, the operator expanded 5G to Birkenhead, Bolton, Gatwick, Lancaster, Newbury, Plymouth, Stoke-on-Trent and Wolverhampton.[108]

In August 2019, Three UK announced the launch of "5G home broadband service" in London. In the second half of 2019, the operator reveals its 5G commercial launch across 25 towns and cities. It also announced the introduction of the world's first 5G-ready, fully integrated cloud core network in a partnership with Nokia. Three UK says it has already successfully tested its new core network with 3,500 of its employees and has started to migrate 4G customer traffic on to the new core.[109]

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[101] See: https://www.commsupdate.com/articles/2018/11/08/three-uk-claims-to-have-committed-gbp2bn-investment-in-5g/
[102] See: https://www.telegraph.co.uk/technology/2018/11/13/ee-roll-5g-16-cities-next-year-demand-led-strategy/
[103] See: https://5gobservatory.eu/5g-trials-at-manchester-airport-by-vodafone/
[104] See: https://5gobservatory.eu/5g-trials-at-manchester-airport-by-vodafone/
[105] See: https://www.mobilenewscwp.co.uk/News/article/o2-activate-5g-network-june-millbrook-testing-ground
[106] See: https://www.commsupdate.com/articles/2019/04/15/o2-to-commence-5g-testing-in-june-2019/
[107] See: https://newscentre.vodafone.co.uk/press-release/5g-uk-live-date-announced-5g-roaming-this-summer/#:~:text=Vodafone%20will%20switch%20on%20its,and%20Spain%20over%20the%20summer.
[108] See: https://www.commsupdate.com/articles/2019/07/18/vodafone-uk-extends-5g-network-coverage/
[109] See: https://www.computerworld.com/article/3428136/three-uk-launches-5g-ready-cloud-core-network-in-time-for-5g-rollout.html

In October 2019, O2 UK announced the launch of its 5G network with a range of new tariffs, including an unlimited data option, at the same price of its 4G equivalents. The commercial launch is based on the partnership with Ericsson and Nokia, following a competitive tender. O2 UK also noted that it expects the new 5G network to supplement its existing 4G connectivity, which remains 'the backbone of the network'.[110]

In January 2020, Vodafone UK announced that it became the first operator in the country to successfully introduce 5G multi-operator radio access network (MORAN) technology.[111]The operator noted that the new platform enables providers to share the same mobile base station, helping to reduce energy usage and the number of masts needed. Moreover, Vodafone UK has confirmed that it started offering 5G roaming in five locations in the Republic of Ireland-- Cork, Dublin, Limerick, Galway and Waterford. Previously, it had made 5G roaming available in Germany, Italy and Spain.[112]

In February 2020, Three UK outlined details for its mobile 5G launch plans. The operator contended that it was the only operator able to meet the International Telecommunication Union (ITU) 2020 standard for full 5G services, by having at least 100MHz of the 5G-suitable spectrum. Three UK also confirmed that all new and existing customers will have access to 5G with no speed caps and at no extra cost on all post-paid, pre-paid and SIM-only tariffs.[113]

in April 2020, BT has signed an agreement with Ericsson for the deployment of its dual-mode 5G Core (Evolved Packet Core and 5G Core), a fully container-based, cloud-native Mobile Packet Core for 4G, 5G Non-standalone and 5G Standalone services as a single fully integrated core. Ericsson highlighted that its 5G Core should help BT create and deliver new services such as enhanced mobile broadband, network slicing, mobile edge computing, mission-critical vertical industry support and advanced enterprise services.[114]

In June 2020, O2 UK also selected Ericsson as the equipment provider for 5G radio access network (RAN) to other regions of the UK as part of its network modernization programme.[115]

In June 2020, EE's 5G service was reported to be live in 80 towns and cities across the country. The company is using a Non-standalone 5G New Radio deployment focused on using the combined power of 4G and 5G technologies. In a second phase from 2022, it will introduce the full 5G core network, enhanced device chipset capabilities, and increased availability of 5G-ready spectrum. A third phase, beginning in 2023, will introduce Ultra-Reliable Low Latency Communications (URLLC), network slicing and multi-gigabit-per-second speeds.[116]

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[110] See: https://news.o2.co.uk/press-release/connecting-britain-o2-continues-5g-switch-on-across-the-uk-in-tyne-and-wear-surrey-and-lincoln/#:~:text=O2%20has%20announced%20that%20its,and%20customers%20in%20the%20UK.
[111] See: https://www.thefastmode.com/services-and-innovations/16218-vodafone-uk-intros-5g-multi-operator-ran-expands-5g-roaming-to-ireland
[112] See: https://www.commsupdate.com/articles/2020/01/14/vodafone-uk-extends-5g-coverage-introduces-moran-technology/
[113] See: https://www.commsupdate.com/articles/2020/02/14/three-uk-confirms-mobile-5g-launch-plans/
[114] See: https://www.ericsson.com/en/press-releases/2020/4/bt-and-ericsson-join-up-to-deliver-cloud-native-dual-mode-5g-core
[115] See: https://www.rcrwireless.com/20200611/5g/ericsson-extends-5g-partnership-uk-02
[116] See: http://5gobservatory.eu/market-developments/5g-services/

In July 2020, Vodafone UK announced that it launched a new 5G standalone (SA) network at Coventry University, in partnership Ericsson, MediaTek, OPPO and Qualcomm. The operator contended that the new network =will be used to show the true benefits of 5G, including ultra-low latency, guaranteed speed performance, and the IoT.[117]

In September 2020, Three UK has signed a deal with British pure fibre provider CityFibre, extending their multi-million EUR 5G backhaul contract signed earlier in 2020. Under the amended contract, the fibre network provider will connect a further 1,300 mobile masts in 59 towns and cities across the UK.[118]

In September 2020, BT announced that Nokia has been selected as a 5G RAN vendor for its commercial operations in the UK. Nokia will supply its AirScale Single RAN (S-RAN) portfolio for both indoor and outdoor coverage, including 5G RAN, AirScale base stations and Nokia AirScale radio access products.[119] Furthermore, under the terms of the deal, Nokia will also optimise BT's 2G and 4G networks and work alongside the carrier on the development of the OpenRAN ecosystem. it will also utilise Nokia Software's ng-SDM and NetAct network management platform, supporting the network evolution to 5G.[120]

Still in September 2020, under this agreement, BT's Nokia-powered network, which is said to currently cover Greater London, the Midlands and rural locations, will reportedly be extended to cover multiple other towns and cities across the United Kingdom, with those locations named as: Aberdeen, Bournemouth, Brighton, Cambridge, Carlisle, Cheltenham-Gloucester, Chesterfield, Dundee, Exeter, Grimsby, Hull, Ipswich, Lincoln, Newbury, Northampton, Norwich, Peterborough, Plymouth, Southampton, Stoke-on-Trent, Swindon, Torbay and York.[121]

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[117] See: https://www.coventry.ac.uk/news/2020/coventry-university-5g/
[118] See: https://www.techradar.com/news/three-expands-5g-backhaul-deal-with-cityfibre
[119] See: https://www.rcrwireless.com/20200929/5g/nokia-secures-5g-ran-contract-from-uk-carrier-bt
[120] See: https://www.nokia.com/about-us/news/releases/2020/09/29/nokia-signs-5g-deal-to-become-bts-largest-infrastructure-partner/
[121] See: https://www.commsupdate.com/articles/2020/09/30/bt-selects-nokia-as-5g-ran-vendor/