Ofcom's future approach to mobile markets

Annexes

Contents

A1. Glossary

Term	Description
5G Non-standalone (5G NSA)	Non-standalone 5G refers to the deployment of a 5G Radio Access Network (e.g. base stations, antennas) combined with a 4G core network (which manages control and signalling information).
5G Standalone (5G SA)	5G built on a 5G core and 5G RAN. The 5G core virtualises network functions and provides the full range of 5G features.
Active infrastructure	The electronic components or elements of the mobile network (i.e. active layer). For example, base stations and servers.
Annual Licence Fee (ALF)	Fees set and charged by Ofcom for the continued use of spectrum, typically after an initial 20-year period.
Augmented Reality (AR)	An enhanced version of the real physical world that is achieved through the use of digital visual elements, sound, or other sensory stimuli delivered via technology.
Big Tech	The set of largest companies in the information technology industry. This includes Amazon, Apple, Facebook, Google and Microsoft, as well as other technological giants, such as Samsung.
Bluetooth	A standard for the short-range wireless interconnection of mobile phones, computers, and other electronic devices.
Core	A network of interconnected nodes which forms the backbone of a communications network. It manages functions such as authentication, authorisation, connectivity and call routing.
Cloud	A type of computing where users have ubiquitous access (i.e. independent of the user location) to scalable computing resources, such as processing and storage, that allow for reduced management on behalf of the user.
Connected device	Any device capable of connecting to a wireless network, comprising of mobile devices (e.g. mobile phones and wearables, smart home devices and connected vehicles).
Cornerstone Telecommunications Infrastructure Limited (CTIL)	A 50/50 joint venture between Virgin Media O2 and Vodafone that owns and operates the MNOs' network sites.
EBIDTA	Earnings Before Interest, Taxes, Depreciation and Amortisation.

End of Contract Notification (ECN)	Messages that providers are required to send to customers that let them know about their best deals when their contracts come to an end.
eSIM	An embedded-SIM, is a form of programmable SIM that is embedded directly into a device, thereby removing the need for a physical SIM card in the device.
Fixed Wireless Access (FWA)	Wireless networks (both national mobile networks and separate independent networks) that provide an alternative to wired networks to deliver traditional fixed broadband services.
G (e.g. 4G, 5G)	Denotes the generation of the mobile network technology. For example, 5G refers to the fifth generation of mobile network technology as defined by the ITU and 3GPP.
GB	Gigabyte. A unit of data (1 gigabyte = 1000 megabytes).
GHz	Gigahertz. A unit of frequency (1 gigahertz = 1000 megahertz).
GSMA	Global System for Mobile Communications Association. The mobile network providers industry association.
High-frequency spectrum	Frequencies above 24 GHz (also referred to as mmWave).
Hyperscalers	The three largest cloud providers: Amazon (via its subsidiary AWS), Google and Microsoft.
IoT, IIoT	Internet of Things, Industrial Internet of Things. Describes the network of physical objects - "things"- that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet.
Long Term Evolution (LTE)	A 4G mobile communications standard.
LoRaWAN	Is a protocol for low power, long range IoT communications developed by the LoRa Alliance
Low-frequency spectrum	Frequencies below 1 GHz (also referred to as sub 1 GHz spectrum).
Machine-to-Machine (M2M)	A broad term to describe any technology that enables networked devices to exchange information and perform actions without manual assistance.
MB	Megabyte. A unit of data (1 megabyte = 1000 kilobytes).
Mbit/s	Megabits per second. A measure of bandwidth in a digital system (1 megabit = 1 million bits).
Medium-frequency spectrum	Frequencies between 1 GHz and 24 GHz.

MHz	Megahertz. A unit of frequency (1 megahertz = 1000 kilohertz).
Mobile Broadband Network Limited (MBNL)	A 50/50 joint sharing venture between EE and Three. It provides a shared site portfolio which supports both shared (3G) and non-shared (2G-5G) technologies.
Mobile device	Any portable device capable of connecting to a wireless network (e.g. smartphones and wearables).
Mobile ecosystem	A collection of hardware and software broadly comprising of mobile devices, mobile operating systems and applications.
Mobile network	A network that uses any of the 1G-5G technologies.
Mesh network	A network in which devices - or nodes - are linked together, branching off other devices or nodes. These networks are set up to efficiently route data, which is passed from one node to the next, until it reaches its target destination.
Mobile internet access	Comprises all wireless connectivity services, including mobile services, (traditional voice and SMS, and mobile data), and internet access delivered over other wireless networks, such as Wi-Fi.
Mobile Network Operator (MNO)	A mobile provider that owns its own mobile network.
Mobile provider	Provider of mobile services. Includes MNOs and MVNOs.
MMS	Multimedia Message Service.
Mobile Edge Computing (MEC)	A decentralised form of cloud computing where data is stored and processed close to the edge of the mobile network, i.e. the physical location where users connect with the mobile network. Also known as Multi-access Edge Computing.
Mobile services	Connectivity services that mobile providers supply to their customers over mobile networks. Includes voice, SMS and data.
Mobile Virtual Network Operator (MVNO)	A mobile provider that does not own the wireless network infrastructure over which it provides mobile services to its customers.
Minimum Viable Scale (MVS)	The minimum level of scale required for an organisation (in this context, an MNO) to be viable at the prevailing price level.
Net neutrality	The principle that all traffic is treated equally, so that users of the internet (rather that their service provider) can control what they see and do online.
Neutral host	An independent third party that provides network infrastructure for use by multiple providers.

Network slicing	Network slicing is a feature of 5G SA networks. It allows an MNO to create multiple virtual networks (slices) on top of its common shared physical infrastructure. The virtual networks are then customised to operate with specific quality of service and meet the specific needs of applications, services, devices, customers or operators.
Not-spot	An area which is not covered by a mobile network.
Online communications services	Number-independent interpersonal communications services (e.g. WhatsApp, email, etc.).
Online services	Everything on the internet/online, comprises of WhatsApp, navigation, etc.
Open Radio Access Network (Open RAN)	Initiative to build RAN products based on an open architecture and on disaggregating hardware from software by using commercial off-the-shelf hardware and software-defined technologies.
Operating system	Software that controls the operation of a device and directs the processing of programs.
Passive infrastructure	The non-electronic components or elements of the mobile network (i.e. non-active layer). For example, sites and towers.
Pay as you go (PAYG)	A type of mobile tariff in which customers purchase a set amount of credit towards mobile minutes, messages and data.
PB	Petabyte. A unit of data (1 petabyte = 1 million gigabytes).
Private network	A mobile network that has been dedicated to a closed group of people and/or devices.
Radio Access Network (RAN)	The equipment on a collection of cell sites of a mobile network that connects customer devices (e.g. handsets) and mobile phone masts using radio spectrum.
Return on Capital Employed (ROCE)	Operating profit (measured as earnings before interest and tax) divided by capital employed.
Shared Rural Network (SRN)	A deployment agreed between the UK Government and the UK's four MNOs to upgrade networks and share infrastructure and sites to help improve 4G mobile coverage in rural areas.
SigFox	A proprietary low-power, long-range narrow band communication solution for sensors and devices (IoT)
SMS	Short Message Service.
SME	Small to medium sized enterprise.

Subscriber Identity Module (SIM)	A small smart card type device that has details of the mobile subscriber including public telephone number and the numbers required by the network to recognise and authenticate the subscriber.
Virtual reality (VR)	The use of computer technology to create a simulated environment.
Virtual Network Functions (VNFs)	Software applications that deliver network functions that were traditionally carried out by proprietary, dedicated hardware.
Wearable	A mobile device that can be worn as an accessory (e.g. smartwatch)
Wi-Fi	A wireless networking technology that allows computers, mobile devices and other equipment to interface with the internet through a wireless router.
Wireless network	Any network that uses wireless technology, including mobile networks and Wi-Fi networks.
Wireless technology	Comprises mobile technology, Wi-Fi and other wireless technologies.
Zigbee	A proprietary low-power, short-range narrow band communication solution for sensors and devices (IoT)

A2. Responding to this discussion paper

How to respond

A2.1   Ofcom would like to receive views and comments on the issues raised in this document, by 5pm on 8 April 2022.

A2.2   You can download a response form from the Ofcom website. You can return this by email or post to the address provided in the response form.

A2.3   If your response is a large file, or has supporting charts, tables or other data, please email it to mobilestrategy@ofcom.org.uk, as an attachment in Microsoft Word format, together with the cover sheet.

A2.4   Responses may alternatively be posted to the address below:

Mobile Strategy team
Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA

A2.5   We welcome responses in formats other than print, for example an audio recording or a British Sign Language video. To respond in BSL:

- Send us a recording of you signing your response. This should be no longer than 5 minutes. Suitable file formats are DVDs, wmv or QuickTime files. Or
- Upload a video of you signing your response directly to YouTube (or another hosting site) and send us the link.

A2.6   We will publish a transcript of any audio or video responses we receive (unless your response is confidential)

A2.7   We do not need a paper copy of your response as well as an electronic version. We will acknowledge receipt if your response is submitted via the online web form, but not otherwise.

A2.8   You do not have to answer all the questions in the discussion paper if you do not have a view; a short response on just one point is fine. We also welcome joint responses.

A2.9   It would be helpful if your response could include direct answers to the questions asked in the discussion paper. The questions are listed at Section 8. It would also help if you could explain why you hold your views, and what you think the effect of Ofcom's proposals would be.

A2.10   If you want to discuss the issues and questions raised in this consultation, please contact Mobile Strategy team by email to mobilestrategy@ofcom.org.uk.

Confidentiality

A2.11   Consultations are more effective if we publish the responses before the consultation period closes. In particular, this can help people and organisations with limited resources or familiarity with the issues to respond in a more informed way. So, in the interests of transparency and good regulatory practice, and because we believe it is important that everyone who is interested in an issue can see other respondents' views, we usually publish all responses on the Ofcom website as soon as we receive them.

A2.12   If you think your response should be kept confidential, please specify which part(s) this applies to, and explain why. Please send any confidential sections as a separate annex. If you want your name, address, other contact details or job title to remain confidential, please provide them only in the cover sheet, so that we don't have to edit your response.

A2.13   If someone asks us to keep part or all of a response confidential, we will treat this request seriously and try to respect it. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.

A2.14   Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's intellectual property rights are explained further in our Terms of Use.

Next steps

A2.15   Following this consultation period, Ofcom plans to publish our conclusions by end 2022.

A2.16   If you wish, you can register to receive mail updates alerting you to new Ofcom publications.

Ofcom's consultation processes

A2.17   Ofcom aims to make responding to a consultation as easy as possible. For more information, please see our consultation principles in Annex 3.

A2.18   If you have any comments or suggestions on how we manage our consultations, please email us at consult@ofcom.org.uk. We particularly welcome ideas on how Ofcom could more effectively seek the views of groups or individuals, such as small businesses and residential consumers, who are less likely to give their opinions through a formal consultation.

A2.19   If you would like to discuss these issues, or Ofcom's consultation processes more generally, please contact the corporation secretary:

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

A3. Ofcom's consultation principles

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

Before the consultation

A3.1   Wherever possible, we will hold informal talks with people and organisations before announcing a big consultation, to find out whether we are thinking along the right lines. If we do not have enough time to do this, we will hold an open meeting to explain our proposals, shortly after announcing the consultation.

During the consultation

A3.2   We will be clear about whom we are consulting, why, on what questions and for how long.

A3.3   We will make the consultation document as short and simple as possible, with a summary of no more than two pages. We will try to make it as easy as possible for people to give us a written response. If the consultation is complicated, we may provide a short Plain English / Cymraeg Clir guide, to help smaller organisations or individuals who would not otherwise be able to spare the time to share their views.

A3.4   We will consult for up to ten weeks, depending on the potential impact of our proposals.

A3.5   A person within Ofcom will be in charge of making sure we follow our own guidelines and aim to reach the largest possible number of people and organisations who may be interested in the outcome of our decisions. Ofcom's Consultation Champion is the main person to contact if you have views on the way we run our consultations.

A3.6   If we are not able to follow any of these seven principles, we will explain why.

After the consultation

A3.7   We think it is important that everyone who is interested in an issue can see other people's views, so we usually publish all the responses on our website as soon as we receive them. After the consultation we will make our decisions and publish a statement explaining what we are going to do, and why, showing how respondents' views helped to shape these decisions.

A4. Consultation coversheet

BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

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

Nothing ☐

Name/contact details/job title ☐

Whole response ☐

Organisation ☐

Part of the response ☐

If there is no separate annex, which parts? _____

_____

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

DECLARATION

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

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

Name   Signed (if hard copy)

A5. Recent regulatory and public policy interventions

A5.1   Regulation and public policy decisions by bodies such as Ofcom the UK and devolved governments, European Commission, and the CMA have also played a role in shaping the mobile sector. We set out here a summary of some of the interventions that affect mobile markets, covering: spectrum management; consumer protection; net neutrality; mobile call termination; network security and resilience; merger control; and numbering policy. This is not exhaustive and does not cover other factors such as competition law and consumer law, which also play an important role.

Spectrum management

A5.2   Spectrum is a finite resource that is used to carry data from place to place. As well as mobile, it is vital for a range of communications services including Wi-Fi, and Bluetooth. It is also needed to deliver TV and radio broadcasts, keep air and shipping lanes safe through radar, and to predict weather and climate changes from space, and many other purposes. Ofcom is responsible for managing spectrum in the UK. Its duties include ensuring its use is optimised and ensuring the availability of a wide range of electronic communications services.[1]

A5.3   In relation to mobile internet access, spectrum policy is important for ensuring efficient use of spectrum; maintaining effective competition; promoting widespread coverage and innovation.

Ensure spectrum is used efficiently

A5.4   We ensure the optimal use of spectrum. In general, we consider that this is most likely to be secured if spectrum is used efficiently. Ofcom has held auctions to assign licences for spectrum for which there is likely to be excess demand, including spectrum harmonised for mobile use. This allows the market to determine the best allocation. Ofcom has made large amounts of spectrum available for mobile use over the past decade, to support new generations of mobile technologies and increases in capacity.[2]

A5.5   With demand for mobile services continuing to grow, we have identified a large amount of additional spectrum for mobile in the mmWave frequencies. The 26 GHz band (24.25-27.5 GHz) was globally identified for mobile services in 2019 and is a pioneer 5G band in Europe with harmonised technical conditions.[3] In addition, the 40 GHz band (40.5-43.5 GHz) was

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[1] See Ofcom, Statement: Supporting the UK's wireless future, 2021 for further information on our spectrum management strategy.

[2] In 2013 our 4G auction for 800 MHz and 2.6 GHz bands raised £2.5bn. This was followed in 2018 by our 5G auction for 2.3 GHz and 3.4 GHz bands which raised £1.35bn, and our 2021 5G auction for 700 MHz and 3.6-3.8 GHz bands which raised £1.36bn.

[3] See Decision 2019/784, as amended by Decision 2020/590

also identified for mobile and as a future 5G band in Europe, with work ongoing to develop harmonised technical standards for 5G.[4]

A5.6   We also plan to award the 1.4 GHz band (1492-1517 MHz), which is internationally-harmonised for downlink-only wireless broadband (supplemental downlink).

A5.7   We set and charge Annual Licence Fees (ALFs) for continued use of spectrum, typically after an initial 20-year period. ALFs are set to reflect the market value of the spectrum (based on its opportunity cost) in order to promote the optimal use of spectrum, in line with our duties.[5]

Maintain effective competition in the mobile market

A5.8   When setting auctions for mobile spectrum, Ofcom has taken steps to ensure that the post-auction distribution of spectrum does not weaken competition among MNOs. Specifically, we have taken steps to prevent significant overall asymmetry of spectrum holdings by introducing a cap of 37% on overall holdings of mobile spectrum by any single provider.[6]

Promote widespread coverage to help ensure everyone is connected

A5.9   Spectrum awards, and spectrum licences, have been associated with a number of measures to promote widespread coverage of mobile networks, in recognition of the social benefits of widespread mobile coverage throughout the UK. For example, the following measures were introduced as part of an auction and/or included in spectrum licences:

   a) Ofcom included a coverage obligation in the 2013 auction of 800 MHz spectrum. As a result, O2 was required under the terms of its 800 MHz licence to provide a minimum level of indoor data coverage to 98% of all UK premises by 31 December 2017, with a minimum of 95% in each of the four nations of the UK.[7]

   b) In 2014, the MNOs agreed with the UK government to provide at least 90% of the UK landmass with a voice service. Ofcom gave effect to this commitment by varying the licenses of the 900 MHz and 1800 MHz spectrum bands.[8]

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[4] In Ofcom 2019 added the 24.25-26.5 GHz band to our Shared Access Licence framework for indoor-only deployment. We plan to consult shortly on proposals to enable millimetre wave bands to be used for new and innovative services, including 5G.

[5] We set ALFs for 900 MHz and 1800 MHz spectrum in 2018, 3.4 GHz and 3.6 GHz spectrum in 2019 and 2100 MHz spectrum in 2021.

[6] We consider that competition may be weaker if one (or more) MNO were able to strategically hoard spectrum, or amass spectrum holdings large enough to allow it to develop an unmatchable competitive advantage. Whilst the cap does not represent a cliff-edge threshold, it remains our judgement that competition concerns in relation to capacity and average speeds may generally arise when one MNO holds around 37% of overall spectrum. See for example Ofcom, Award of the 700 MHz and 3.6-3.8 GHz spectrum bands, March 2020. For further information see section 1 (1.6-1.8) and section 4.

[7] For further information see Ofcom, Mobile coverage obligations, July 2021.

[8] In December 2014, the UK's four MNOs signed an agreement with the UK Government committing to provide a voice service to 90% of the UK landmass by 31 December 2017. In January 2015, Ofcom set out our approach to compliance with this obligation. The MNOs were required to self-certify, by 31 December 2017, that they had reached the 90% coverage requirement. All MNOs did this, and we have completed our assessment of the information provided in support of these

c) In 2020, the MNOs agreed a Shared Rural Network plan with the UK Government to improve 4G mobile coverage,[9] prompted by Ofcom's earlier proposal to include coverage obligations in the 700 MHz auction.[10] Under the agreement, each MNO committed to reaching 88% coverage of UK landmass by 2024, and 90% of the landmass within 6 years from 2020 (subject to certain conditions), with an expectation that this will see the 'at least one operator' footprint reach 95% of UK landmass by 2025. All operators agreed to provide 4G coverage to 88% of the UK landmass by 2024, rising to 90% by January 2027.[11] The MNOs agreed to their 900 MHz and/or 1800 MHz licences being varied by Ofcom to give effect to these commitments in the form of new coverage obligations.[12] Other measures have also been taken to extend coverage, including the Scottish Government's 4G Infill programme to deliver 4G mobile infrastructure to up to 55 mobile not-spots across Scotland by March 2023.[13]

Promote innovation

A5.10   Ofcom has taken steps to enable a wider range of organisations to access mobile spectrum to help meet local connectivity needs, such as industrial applications. Users can apply for local access licences to access spectrum currently unused by MNOs in a particular area,[14] and spectrum in the 3.8-4.2 GHz, 1800 MHz and 2300 MHz bands is also available for localised deployment through the shared access licences.[15] Those wishing to test, develop, research, trial or demonstrate radio equipment in the UK can apply for a trial or innovation licence.

A5.11   In 2020 we made spectrum in the Extremely High Frequencies bands, including spectrum above 100 GHz, available through a simple, low cost national licence.[16] By providing access to these bands we are enabling academia and industry to develop new technologies that may become part of a future 6G mobile standard.

Empowering and protecting consumers

A5.12   Ofcom wants to ensure that customers are protected from harm, treated fairly and are able to get the best deal that meets their needs. In the past few years we have put in place significant interventions to facilitate this. For example, we have:

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certifications of compliance and carried out additional tests to understand the basis on which the MNOs certified their compliance.

[9] DCMS, Shared Rural Network, March 2020.

[10] Ofcom, Award of the 700 MHz and 3.6-3.8 GHz spectrum bands, December 2018.

[11] MNO licences were amended in July 2021 to change the subsequent coverage deadline (relating to the 90% target) to January 2027. This reflects changes made to the Grant Agreement between the four mobile operators and Government in light of the current process for subsidy control.

[12] Details can be found in the licence copies published on the Mobile and Wireless Broadband below 5 GHz page.

[13] Ofcom, Connected Nations 2021: Scotland, p. 29. Updates – including timescales for 4G service availability – are also being published on the Scottish Government's website, see here.

[14] Ofcom, Local Access Licence Guidance, July 2019.

[15] Ofcom, Shared Access Licence Guidance, July 2019.

[16] Ofcom, Spectrum Access: EHF Licence Licensing guidance document, 2021.

- **Introduced 'Auto-Switch'[17] reforms**, to make it easier for people to switch mobile provider. Customers can now switch their provider by sending a simple, free text message to get their code[18] from their existing provider, rather than calling them.[19] This puts customers in control of the contact they have with their existing provider and prevents customers from being faced with often unwanted attempts by their existing providers to persuade them to stay, making the switching process quicker and easier.
- Given customers **protections from mid-contract price rises** (that go beyond any changes clearly set out in the original contract) by requiring operators to provide at least one month's notice of the price rise and allowing customers to exit their contract without penalty if they choose to.[20] From June 2022 these protections will be extended to include any changes to the agreed contract terms that are not to the customer's benefit, and any contracts forming part of a bundle.[21]
- Required providers to send **end of contract notifications** to let customers know about their best deals as their contracts come to an end.[22] These help prevent customers unknowingly ending up on a higher out-of-contract tariff, and help them to make an informed decision about which mobile tariff they should be on. These requirements were part of a wider package of measures to implement the European Electronic Communications Code.[23]
- **Prohibiting mobile providers from selling locked handsets to consumers.** This change took effect in December 2021 and is designed to ensure that locked devices do not disincentivise customer switching.[24]
- Secured **commitments to apply a discount to the monthly price paid by bundled customers that are out-of-contract** from three of the four MNOs (all apart from Three).[25] These discounts help customers on bundled mobile handset and airtime contracts who may be paying a higher price when they stay out-of-contract instead of switching to a SIM-only deal. Our recent review of these pricing commitments found that the annual aggregate overpayment among this group of mobile customers had more than halved, from £182m per year in 2018 to £83m per year in 2020.[26]
- **Taken steps to protect vulnerable consumers**. These include rules[27] introduced in 2018 requiring providers to have policies and procedures in place to make sure vulnerable customers are treated fairly, and our 'Treating vulnerable customers fairly' guide for

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[17] More information is provided in the 'Switching mobile phone provider' page of Ofcom's website.
[18] These codes are Porting Authorisation Code if keeping the number or Service Termination Authorisation Code if not keeping it.
[19] Ofcom, Text to switch, June 2019.
[20] Ofcom, Contracts: Changes to terms and conditions.
[21] See Ofcom, Implementation of the new European Electronic Communications Code, 11 October 2021 update.
[22] Ofcom, Companies must tell customers about their best deals, February 2020.
[23] Ofcom, Statement: Implementation of the new European Electronic Communications Code, December 2020.
[24] Ofcom, Mobile companies now banned from selling locked handsets, December 2021.
[25] The level and approach each provider took to these discounts varied, taking account of the different levels of savings available to their out-of-contract customers if they switched to a similar SIM-only tariff. See Ofcom, Making sure customers are treated fairly: Progress update on Ofcom's work to ensure fairness for customers, January 2020.
[26] See Ofcom, Helping customers get Better Deals, November 2021.
[27] See General Conditions C5.2-5.5. This aims to ensure that communications providers give sufficient consideration to the particular needs of people whose circumstances may make them vulnerable.

industry published in 2020.[28] We are also reviewing the affordability of communications services including mobile,[29] and have published a review of support for customers in debt or arrears.[30]

- **Introduced rules to require providers to make an emergency video relay service available** to support deaf British Sign Language users, (effective 17 June 2022).[31]

A5.13   Another example of a recent intervention to protect customers is the requirement in UK legislation[32] that all mobile providers offer customers the option of a cap on the monthly cost of bills to help prevent bill shock.[33] Customers can choose the level of the cap and it can be changed at any time.[34] The UK Government also secured a voluntary agreement with major mobile networks to introduce protection for consumers from large bills run-up on stolen mobiles.[35]

Fairness for Customers commitments

A5.14   To promote the fair treatment of customers, we launched the Fairness for Customers commitments with industry in 2019. These commitments set out six high-level areas where we expect providers to be proactive in promoting fairness; and represent a more principles-based approach.[36] We published a progress update on these commitments in 2021.[37]

A5.15   In addition, we published the Fairness Framework[38] in 2020. This explains how we are likely to assess fairness concerns when they arise and the kinds of problems that might prompt action from us.[39]

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[28] This guide includes suggested examples of measures that providers could adopt to offer vulnerable customers the help, support and services they need. See Ofcom, Treating vulnerable customers fairly: A guide for phone, broadband and pay-TV providers.

[29] Through this ongoing work, we have encouraged fixed and mobile providers to consider introducing discounted tariffs to support low income households with internet access. See Ofcom, Affordability of communications services: summary of findings, July 2021.

[30] Ofcom, Review of measures to protect people in debt or at risk of disconnection: Call for inputs, July 2021.

[31] Ofcom, Emergency video relay statement, June 2021.

[32] Legislation.gov.uk, Communications Act 2003, changes for Section 124S.

[33] This applies to new customers and to any existing customers who agree to extend their contract or enter into a new contract.

[34] Ofcom, Mobile bill limits, 2018.

[35] DCMS, Government action secures end to shock mobile bills, March 2015.

[36] The Fairness for Customers Commitments include ensuring customers get a fair deal which is right for their needs; get the support they need when their circumstances make them vulnerable; are supported to make well-informed decisions with clear information about their options; have services work as promised, reliably over time; can sign up to, leave or change their services quickly and smoothly; and can be confident that fair treatment is a central part of their provider's culture.

[37] Ofcom, Fairness for Customers Commitments progress review, May 2021.

[38] Ofcom, Making communications markets work well for customers A framework for assessing fairness in broadband, mobile, home phone and pay TV, January 2020.

[39] The Fairness Framework provides us with a tool to help assess fairness concerns in the round. We expect to use our Fairness Framework to assess individual practices and whether they might be considered unfair, on a case-by-case basis. In deciding whether to take formal action against practices we consider are unfair to customers, we will continue to apply our existing regulatory principles and act in line with our statutory duties.

Roaming

A5.16   Since 31 December 2020, the EU rules on roaming charges no longer apply in the UK. This means that the amount mobile providers can charge UK mobile customers using their service in EU countries, as well as in Norway, Iceland and Liechtenstein, is no longer capped. While providers did not reintroduce charges straight away, some have announced that they plan to reintroduce EU roaming charges in 2022.[40]

A5.17   Ofcom does not have the power to prevent mobile companies from charging customers for using their services when travelling, but there are a number of measures in place to protect people from running up unexpectedly high roaming bills. Providers are required to:

- Give their customers at least a month's notice of any contract changes. Where those changes will particularly disadvantage customers, providers must also give them a right to exit their contracts without penalty if they choose.
- Publish details of roaming charges on their website and send customers an alert with pricing information when they start roaming. The must also send an alert when the customer starts using data whilst roaming.
- Take reasonable steps to protect customers from paying additional charges and make information available on how to avoid inadvertent roaming. This is particularly important for customers in Northern Ireland given the risks of inadvertent roaming in the Republic of Ireland.
- Apply a default cap of £45 (excluding VAT) per month on data roaming charges. Providers must send their customers an alert once they have reached 80% of the cap and another once they reach the limit. After this, providers must stop charging for data roaming unless a customer opts in to continue.[41]

Net neutrality

A5.18   Net neutrality is the principle that all traffic should be treated equally so that users of the internet can control what they see and do online rather than the internet service provider (ISP) that connects them to the internet. EU rules aimed at protecting the open internet took effect in 2016,[42] and became domestic UK law following the conclusion of the Brexit transition period. The rules require MNOs, as internet access providers, to treat all internet traffic equally and not favour certain websites or services, subject to reasonable traffic management measures and certain other limited permitted exceptions. It is recognised that ISPs may also want to provide other connectivity services that are optimised for specific content or services. The rules allow for this, and such services are commonly known as 'specialised services'. Ofcom is responsible for monitoring and ensuring

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[40] These plans and times vary by provider. For a summary, see BBC, Mobile roaming charges in Europe: What you need to know, 10 January 2022.
[41] DCMS, Using your mobile in EU and EEA countries, December 2020.
[42] Regulation (EU) 2015/2120 of the European Parliament and of the Council of 25 November 2015 laying down measures concerning open internet access and retail charges for regulated intra-EU communications and amending Directive 2002/22/EC and Regulation (EU) No 531/2012.

compliance with the net neutrality rules[43] and we can issue guidance on compliance with them.

A5.19   We have begun a review of how the UK's net neutrality framework is functioning, publishing a call for evidence in September 2021.[44] We recognise that, since the net neutrality rules were introduced (in 2016), there have been significant changes in the wider environment such as the emergence of new, innovative and evolving technologies and services, as well as increasing capacity demands. Such changes signal that it is now an appropriate time to review the current framework.

A5.20   Our review is looking at a range of areas[45] to ensure the net neutrality framework continues to best serve citizen and consumer interests and promote access and choice, while also supporting digital innovation and investment. The MNOs have argued that the current framework is too restrictive, is limiting innovation and leading to inefficient network management. Other stakeholders, in particular content providers, argue that the framework works well and has been central in supporting the development of new and innovative services. We will be assessing these arguments as part of our review, as well as considering whether there may be benefit in providing updated guidance on our approach to assessing compliance with the current rules. Any changes to the rules in future would be a matter for the UK Government and ultimately Parliament. We expect to publish our initial findings in Summer 2022.

Mobile call termination

A5.21   For voice services, Ofcom sets the wholesale rate that MNOs can charge other operators to connect calls to their networks. This is to prevent competition distortions in the market, because originating providers have no choice other than to buy the termination service from the terminating provider (and there have historically been significant flows of traffic into and out of the mobile sector). When we capped charges in 2011, this led to an 80% reduction in mobile termination rates over the subsequent four years.[46] Following a recent Ofcom review of mobile call termination rates, the decision has been made that we will continue to regulate mobile call termination rates for the period 2021-2026.[47]

A5.22   Ofcom does not apply wholesale regulation to SMS services. We consider there to be little evidence to suggest that there are competition distortions in the market that harms consumers.[48]

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[43] Ofcom, Monitoring compliance with the net neutrality rules, November 2021.
[44] Ofcom, Net Neutrality Review: call for evidence, September 2021.
[45] We are looking into a number of issues, such as the role of effective traffic management, specialised services and zero-rating, for example.
[46] Ofcom, Lower mobile rates to benefit consumers, March 2011.
[47] Ofcom, Statement: Wholesale Voice Markets Review 2021-26, March 2021.
[48] SMS services have historically accounted for a relatively small proportion of revenues and network usage, and there has been little traffic in and out of the mobile sector. Ofcom has also observed a recent decline in SMS and MMS use: the average mobile connection sent 51 messages per month in 2020, 17 fewer than in 2019. The main driver of this decline is the popularity of online messaging services like WhatsApp, Facebook Messenger and Instagram. See Ofcom, Communications Market Report 2021.

Network security

A5.23 Network resilience and security measures aim to protect customers, businesses, and the UK economy from major network failures or security breaches. This is a growing area of focus for Government and Ofcom, recognising society's increased reliance on communications infrastructure and an expectation that mobile connectivity will become more important in the future.

A5.24 Communications providers already have some security and resilience obligations under the Communications Act 2003,[49] which include the requirements to manage risks to network security, to protect network availability, and to report to Ofcom any breaches of security or reductions in availability. The new Telecommunications (Security) Act 2021[50], seeks to further strengthen network security by giving the UK Government new powers to increase the security standards of the telecoms networks, including removing the threat of high-risk vendors and strengthening the security framework for 5G technology. It also gives Ofcom wider powers to monitor and assess operators' security, alongside enforcing compliance with the new law.

A5.25 In addition, the Government has been enacting a 5G Supply Chain Diversification Strategy, which aims to avoid the risk of the UK becoming overly reliant on too few equipment vendors following the decision to remove Huawei equipment from networks. The strategy has three core strands: supporting incumbent suppliers; attracting new suppliers to the UK market; and accelerating the development and deployment of open-interface solutions.[51] Ofcom has been advising the Government on its approach here.

Merger control

A5.26 The Competition and Markets Authority (CMA) has jurisdiction for merger control in the UK. It may request advice from Ofcom in any mergers relating to the communications sector.[52]

A5.27 In recent years, merger control has played an important role in how the market structure has developed. In particular:

- The European Commission[53] provided clearance of the Orange/T-Mobile merger in 2010 and blocked the proposed Three/O2 merger in 2016, although its decision was annulled by the General Court of the European Union in 2020. The European Commission has subsequently appealed the General Court's decision to the European Court of Justice.[54]

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[49] This relates to sections 105A and 105B. The Act also confers on Ofcom the powers to use information gathering and enforcement provisions to investigate, rectify, and penalise any infringement of these obligations by providers.
[50] Bills.parliament.uk, The Telecommunications (Security) Act, December 2021.
[51] DCMS, 5G Supply Chain Diversification Strategy, December 2020.
[52] The Office of Fair Trading (OFT) held jurisdiction for merger control in the UK until it was dissolved and superseded by the CMA in 2014.
[53] The European Commission has oversight of major cross-border mergers within the EU. Following the end of the Brexit transition period, the Commission's oversight under the EU Merger Regulation no longer applies in the UK.
[54] European Court of Justice case C-376/20 P, Appeal lodged 7 August 2020.

- The Office of Fair Trading cleared the Cornerstone network sharing arrangement in 2012.
- The CMA provided clearance of the BT/EE merger in 2016, the Cellnex/Arqiva merger in 2020 and the Virgin Media/O2 merger in 2021 and it is currently reviewing the proposed acquisition of the passive infrastructure assets of CK Hutchison Networks Europe Investments S.À R.L by Cellnex.[55]

Numbering Policy

A5.28   As part of our statutory duties, Ofcom administers the UK's telephone numbers. This includes the publication of the National Telephone Numbering Plan, setting out the telephone numbers available for allocation and any restrictions on how they may be adopted or used.[56]

A5.29   In 2015 we implemented changes to non-geographic call services (specifically the 080, 084, 087, 09, 116 and 118 number ranges). These included new detailed rules on the structure of charges, and obligations on telephone companies, number range holders and operators of these numbers on the promotion of the charges so that consumers better understand the prices that they face.[57] As part of these changes, we also made 080 and 116 numbers free to call from mobile phones, bringing them in line with landline calls and helping to reduce out-of-allowance charges for consumers.

Overview of recent interventions

A5.30   Figure A5.1 provides a timeline of some of the key regulatory interventions that have been made over the last 10 years.

Figure A5.1: Timeline of key recent regulatory and public policy interventions[58]
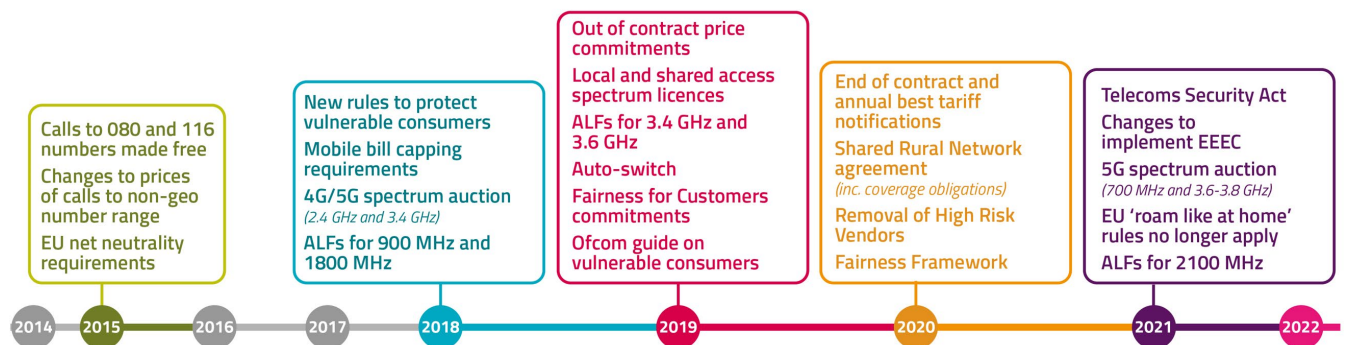
Source: Ofcom

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[55] CMA, Cellnex/CK Hutchison UK towers merger inquiry.

[56] Mobile numbers begin with the digits 071 to 075 and 077 to 079 inclusive and are designated for Mobile Services in the Numbering Plan.

[57] Ofcom, Telephone charges made simpler, June 2015.

[58] Ofcom's regulation of mobile termination rates has applied throughout this period. This figure does not include merger decisions.

A6. Approach to calculation of return on capital employed

A6.1   In Section 6 we summarise our analysis of the Return on Capital Employed (ROCE) for the industry. This annex provides further details behind our calculations.

A6.2   We define ROCE as operating profit (measured as earnings before interest and tax) divided by capital employed. This measure of ROCE can then be compared to the pre-tax cost of capital over the relevant period.

A6.3   To estimate ROCE, we reviewed the financial statements of the main UK trading entities, which most closely capture the operations of each MNO:

- EE (EE Ltd owned by BT Group Plc);
- Vodafone (Vodafone Ltd owned by Vodafone Group Plc);
- Virgin Media O2 (O2 Holdings UK Ltd ultimately owned by Liberty Global Plc and Telefonica S.A.); and
- Three (Hutchison 3G UK Ltd owned by CK Hutchison Holdings Limited).

A6.4   We considered the last four years of financial statements. Specifically, this covers the period from January 2017 to December 2020 for Virgin Media O2 and Three, and the period from April 2018 to March 2021 for EE and Vodafone.[59]

Accounting ROCE

A6.5   For the numerator, we took the operating profits from the accounts, adjusted for exceptional items in some cases.[60] Other than adjusting for exceptional items, we took the subsidiary accounts largely as representative of the performance of each of the MNOs.[61]

A6.6   For the denominator, we defined capital employed as total tangible assets (including the right-to-use assets following the adoption of IFRS16), plus total intangible assets (including the net book value of spectrum), any other long-term operating assets and accounting goodwill.[62]

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[59] We chose this period as this is the longest available period with a consistent set of financial statements for EE, following BT's acquisition of EE. EE accounts prior to 2017-18 adopt significantly different accounting policies in several areas.

[60] Primarily these exceptional items represent: Vodafone restructuring charges in 2018 and gain on sale of the Cornerstone joint venture in 2020; and Three's tax dispute with HMRC in 2018 and 2019.

[61] For example, we have not reviewed the transfer pricing arrangements which might be affecting certain reported costs.

[62] We have effectively assumed net working capital of zero, for simplicity. The net working capital position, at financial year end, is positive for some MNOs and negative for others. Overall, given the magnitude of net working capital, this is unlikely to significantly impact the average calculated returns, and so we have not undertaken a detailed review of working capital balances of each MNO. Goodwill associated with BT Group's purchase of EE is not recorded in EE Ltd's accounts, however, to understand the impact of including it on our industry ROCE, we have included the goodwill amount recorded in BT Group's accounts in EE's capital employed.

A6.7   On this basis, we estimate an average industry ROCE of 5.5% over the last four years.[63] There is however significant variation amongst the MNOs:

a) Returns for EE and O2 are above the cost of capital over this period.

b) Vodafone has reported operating losses over the relevant period, producing a negative ROCE.

c) Three's returns are below the cost of capital on this measure.

Economic ROCE

A6.8   To understand returns in the context of the competitive dynamics of the industry, the levels of profits earned, and the capital employed should reflect the economic value of resources involved. This may differ from accounting values. Specifically, the capital employed used to estimate ROCE should reflect the current value of the assets to the business, which in most cases will be their current replacement cost.[64] We refer to this as economic ROCE.

A6.9   The two main components of the MNOs' balance sheets, where accounting values may require adjustment, are goodwill and spectrum.

A6.10   *Goodwill* is not a separately identifiable asset but is a balancing figure between the purchase price and the fair value of the assets. To understand whether market dynamics allow operators to earn sufficient returns, it is therefore generally appropriate to exclude it from the calculation of the capital employed.[65] This approach avoids the risk of capitalising the value of any excess profits that the business is able to generate, which may be reflected in the purchase price and hence the purchased goodwill.[66]

A6.11   Excluding goodwill from capital employed increases the average industry ROCE from 5.5% to 10.5%. Excluding goodwill significantly increases accounting returns for O2 and EE but has relatively limited impact on Three's and Vodafone's returns.

A6.12   The net book value of *spectrum* is also likely to differ from the current replacement cost. The net book value will capture the (amortised) historic amounts paid in spectrum auctions which are unlikely to reflect the cost of replacing this spectrum today (e.g. the 2100MHz spectrum acquired in 2001). Further, not all spectrum used by MNOs will be recognised on

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[63] All ROCE values are rounded to the nearest half a percent.
[64] This is consistent with the CMA's approach to calculating historic profitability, as part of market studies or investigations. For example, the asset valuation principles are discussed in the CMA's 2016 energy market investigation (Appendix 9.10), paragraphs 13-19.
[65] See, for example, the CMA's 2016 energy market investigation (Appendix 9.10), paragraphs 60-61.
[66] Intangible assets which meet the accounting criteria for being recognised as intangibles would not be included in accounting goodwill. If there are intangible assets not recognised on the balance sheet, one option is to identify historic expenditure associated with creating the asset (e.g. R&D spend, customer acquisition costs) and capitalise it instead. However, this has the effect of both increasing the capital employed and the operating profit (since any depreciation of the newly created asset is typically less than the original amount expensed), with the net impact on ROCE not necessarily that significant. Further, this approach still needs to reflect the costs of creating the intangible asset, rather than the implicit purchase price of the asset on acquisition.

the balance sheet (e.g., the 900 MHz and the 1800 MHz spectrum for which MNOs pay annual licence fees).[67]

A6.13   To understand the significance of revaluing spectrum on ROCE, we estimated the current market value for each spectrum band, drawing on evidence from recent auctions and Ofcom's decisions on annual licence fees.[68] We assumed a constant value for spectrum for the full period of our analysis, with no amortisation over the period (effectively assuming the spectrum has an indefinite asset life).[69] This is a simplified approach, however, we are primarily interested in the directional impact of adjusting for spectrum values, rather than a precise figure.[70]

A6.14   Overall, this approach implies a lower overall value for spectrum compared to the accounts. Coupled with higher operating profit (adjusted by adding back the accounting amortisation of spectrum), this increases the industry average economic ROCE to 12.0% over the period. There remains significant variation amongst the operators (as illustrated in Figure 6.2). Returns for EE and Virgin Media O2 have been firmly above the cost of capital, while returns for Vodafone have been below. Three's returns have fallen below the cost of capital in the last two years.

A6.15   However, at the industry level, average ROCE on an economic and accounting basis (excluding goodwill) are both above any objective measure of the cost of capital which at most was 9.1% and lower still based on more recent evidence (7.8% pre-tax nominal).[71]

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[67] Capitalising this spectrum recognises it is an asset that a mobile operator needs to either own (or effectively lease from Ofcom/government) in order to derive future economic benefits in the market, regardless of how its value is recorded in the accounts.

[68] We converted all the values into April 2021 prices, consistent with our latest ALF decision. See Ofcom, Annual licence fees for 2100MHz spectrum statement, 13 December 2021. Based on this analysis we have estimated current spectrum values by MNO of: 1) Vodafone – c.£2.4bn; 2) Virgin Media O2 - c.£2.0bn; 3) Three – c.£1.2bn; and 4) EE – c.£2.7bn.

[69] Our analysis covers the four years to December 2020 / March 2021 (depending on operator). Therefore, we excluded spectrum bands which have been purchased to deliver 5G (i.e.700MHz, 3.4 GHz and 3.6-3.8GHz), as we do not expect this spectrum to have generated any meaningful profit over our analysis period.

[70] We could have assumed spectrum value changes over time, e.g. with inflation. This would then require recognising the holding gains on assets every year in operating profit. We could have also chosen to amortise the spectrum, but then this would require assumptions about the average remaining useful life of each spectrum band.

[71] Between 2017 and 2018 this was taken from MCT 2015-2018 (paragraph 7.46) and between 2018 and 2021 this was taken from MCT 2018 - 2021 (paragraph 5.40). A pre-tax real cost of capital of 7% equates to a pre-tax nominal cost of capital of 9.1% assuming CPI of 2%. More recently, a cost of capital of 7.8% was used in the MCT 2021-2026 (A2.39).