
Future of interconnection and call termination

First consultation

CONSULTATION:

Publication date: 11 April 2019

Closing date for responses: 6 June 2019

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1. Overview

In February we published our policy statement on the future of fixed telephony services. This set out some of the potential benefits to customers as phone companies move their landline services to newer ‘internet protocol’ (IP) technology. We explained how Ofcom’s rules mean that phone users must receive equivalent protections however their landline phone service is delivered. We also set out the roles and responsibilities of different organisations, and our expectations of telecoms providers as they make these changes.

This migration to IP has implications for how we regulate telephone services. In this document, we discuss the factors that may influence future regulation, and potential options for the future regulatory framework.

What we discuss – in brief

Where regulated prices for calls between networks apply. When a call is made from a customer on one network to a customer on another network, the receiving network typically charges for connecting (or “terminating”) the call. For calls to BT landlines, we cap those charges only where the call is handed over using traditional switched technology at one of BT’s 600 local exchanges. We considered this regulation sufficient to constrain charges for all calls, regardless of where and how they are connected between networks. As telecoms providers move to IP, and use of legacy switched technology diminishes, this constraint may weaken and BT may have the ability and incentive to over-charge for connecting calls. So, we may need to reconsider where regulated prices apply.

Regulation of interconnection circuits. We currently regulate the prices that BT can charge for the connections between other IP networks and BT’s local exchanges. When all networks are IP, the need for regulation may erode, but we need to consider whether regulation is needed during migration.

Ensuring all calls are connected. BT has an obligation to ensure calls can be connected between any providers. With IP, barriers to interconnection may decrease, and this obligation may no longer be required.

Technical standards. Common technical standards may be needed to ensure call quality. We seek views on when we should consider this risk, and potential measures which could mitigate it.

Call termination charges. Convergence of fixed and mobile – and the emergence of alternative calling platforms, including one-way calling services – may lead to changes in how regulated prices are set. At the same time, the new European Electronic Communications Code (EECC) will impose caps on call termination charges across the EU from 2021. These are likely to result in a significant reduction in mobile call termination charges. We seek views on how we should take these factors into account when setting regulated prices.

This overview is a simplified high-level summary only. Any proposals we make, and our reasoning, are set out in the full document.

Context

- 1.1 In February, we published our statement on the future of landline services. This set out some of the potential benefits to customers as phone companies move their landline services to newer ‘internet protocol’ (IP) technology. We explained how Ofcom’s rules mean phone users must be protected equally regardless of how their landline phone service is delivered. We also set out the roles and responsibilities of different organisations, and our expectations of telecoms providers as they make these changes.
- 1.2 Telephone calls are important to many people and businesses. Around eight in ten UK households (81%) have a home phone service and 94% of adults use a mobile phone.¹ Nearly all (96%) small and medium sized businesses use landlines and most (64%) use mobile phones.² More than 200 billion minutes of phone calls a year are made in the UK, which generates call revenues for industry of more than £3bn.³
- 1.3 Although different ways of making calls have emerged - such as ‘Over The Top’ (OTT) voice and messaging applications - and usage of traditional telephone services is falling, phone calls are likely to remain important. As with other platforms, the more people connected to a telephone network, the more each user benefits from the option to contact others. What makes phone services stand out is that it is an open platform, where anyone using a phone service can call any other user, whatever network they are on.
- 1.4 UK telephone networks are undergoing substantial change, as telecoms providers gradually move their landline customers from the country’s traditional telephone network – the ‘public switched telephone network’ (PSTN) – to IP technology.
- 1.5 For most customers, switching to an IP-based service should be straightforward. They will continue to receive what they recognise as a traditional phone service and will keep their existing telephone number. For many, the only change will be that their telephone service will be delivered via a socket on their broadband router rather than a traditional telephone socket. For most mobile customers, the migration will be seamless as networks and mobile handsets move to 4G.
- 1.6 These changes create opportunities. For example, to help identify and prevent nuisance calls and to improve the quality of phone calls. Therefore, it is important that regulation is kept under review through these changes.
- 1.7 Today, we have published three consultations on the future use of phone numbers, and the arrangements between networks. Our aims are to:

¹ Ofcom Technology Tracker H1 2018. See Ofcom, 2018. *Communications Market Report*, p.11.

https://www.ofcom.org.uk/data/assets/pdf_file/0022/117256/CMR-2018-narrative-report.pdf.

² A proportion which may have increased since the latest survey we commissioned. Jigsaw, the SME experience of communications services: research report, 2016.

https://www.ofcom.org.uk/data/assets/pdf_file/0030/96348/Ofcom-SME-consumer-experience-research-2016-Report.pdf

³ Ofcom data tables. Annual minutes and voice revenues for fixed and mobile to Q3-2018.

<https://www.ofcom.org.uk/research-and-data/telecoms-research/data-updates/telecommunications-market-data-update-q3-2018>.

- **Promote competition between providers** of phone services, recognising the changing market, where OTT, social media and messaging platforms offer alternatives to traditional phone calls.
- **Promote confidence in phone numbers and services** by tackling nuisance and scam calls and addressing pricing practices that lead to unexpected or unreasonable bills.
- **Protect people from harm** by making sure they continue to have access to important services.

This document and next steps

- 1.8 In this document we consider the implications of the migration of phone networks to IP technology for our regulation of interconnection and call termination. We consider how regulation may need to evolve to ensure people and businesses benefit from an efficient and innovative market, and from better-quality phone calls.
- 1.9 As to how regulation might need to change to secure these outcomes, we look at: where regulated prices for calls between networks may apply; whether regulation of interconnection circuits is likely to be needed during migration; whether BT's obligation to ensure calls can be connected between any providers is likely to still be required; how we might secure standardisation in IP interconnection to maintain service reliability and quality; and the factors that may impact our approach to setting call termination rates in future.
- 1.10 The current regulatory charge controls, which apply to call termination and interconnection charges, expire in March 2021. Responses to this consultation will be used to inform future proposals on interconnection and termination markets, which we expect to publish in early 2020.
- 1.11 As industry embarks on a significant change in technology, we consider it is important to invite comments from our stakeholders on our emerging thinking.
- 1.12 This first consultation runs until 6 June 2019.

2. Background

Introduction

- 2.1 The market for voice calls has seen considerable change over the past two decades. Use and pricing of mobile and fixed line voice services have converged, prices have fallen and most mobile and fixed telephony voice calls are now included in call allowances. Technological developments have allowed alternatives to telephony to emerge, such as OTT VoIP and Messaging. The widespread take-up of these alternatives has contributed to declining use of fixed line telephony.
- 2.2 It is against this backdrop that fixed telecoms networks in the UK are undergoing a significant technology change as providers transfer telephone services from legacy circuit switched networks to IP networks. This means that the way fixed telephone services are delivered will change.
- 2.3 The migration to IP gives rise to a range of issues, as described in our recent publication on the future of fixed telephone services.⁴ One of these is how our wholesale regulation might change as a result of migration: in particular the regulation of interconnection, call termination and end-to-end connectivity.
- 2.4 This First Consultation considers the policy issues that may arise as the fixed telecoms industry completes its migration to IP, such as the applicability of fixed call termination rates, interconnection, securing the standardisation needed for interconnection to maintain reliability and call quality, and the future of BT's End-to-End Connectivity Condition.⁵ Finally, it considers the approach to setting future termination rates for both fixed and mobile numbers. This First Consultation does not address the future regulation of non-EEA call termination nor wholesale call origination (WCO).
- 2.5 This section sets out the relevant trends and technical background to this paper.

Technical context

- 2.6 Traditionally, fixed telephone services in the UK have been provided by dedicated circuit-switched telephone networks, most recently networks which use Time Division Multiplexing technology (TDM networks). However, over the last decade, a technology transition has been underway as telecoms providers have begun to transfer services to modern Internet Protocol based networks (IP networks) which use a common infrastructure for both broadband and telephone services.

⁴ Ofcom, 2019. *The Future of Fixed Telephone Services: Policy positioning statement*.

https://www.ofcom.org.uk/_data/assets/pdf_file/0032/137966/future-fixed-telephone-services.pdf.

⁵ The end-to-end connectivity obligation is an access condition on BT under sections 73 and 74 of the Communications Act 2003. It requires BT to purchase wholesale call termination services for any telecoms provider that reasonably request it, as soon as reasonably practicable and on reasonable terms and conditions, including charges.

- 2.7 Whilst many fixed line telecoms providers (including major operators such as Sky and TalkTalk) have already made this transition from TDM networks to IP networks, other major fixed line telecoms providers including BT, Virgin Media and KCOM currently provide most of their fixed line telephone services using TDM networks.
- 2.8 During the next few years, this transition will enter a second phase as the remaining telecoms providers transfer their fixed line telephone services to IP based networks.
- 2.9 Openreach has announced that it will withdraw its Wholesale Line Rental (WLR) products by 2025 in preparation for the withdrawal of BT's TDM network.⁶ As a result, over 16 million retail telephone lines that use WLR will have to be migrated to IP networks. We understand that most other major fixed line telecoms providers are working to similar timescales for withdrawing their TDM networks and that consequently, the transition to IP networks is likely to be largely completed by around 2025.

Connections between networks

- 2.10 A characteristic of communications networks is that they exhibit positive network effects, meaning that when an additional customer joins the network, the value of the network to all other users increases due to the possibility of communicating with the new user. To ensure that this benefit is harnessed across all networks, and some undesirable downsides of network effects are avoided,⁷ an essential feature of public telephony services is that any retail telephone user can call any other telephone user on their provider's network and those on all other providers' networks. This is known as 'End-to-End connectivity'.⁸
- 2.11 In order to facilitate End-to-End connectivity, our regulation focuses on:
- a) Interconnection: This is the linking (whether directly or indirectly by physical or logical means) of one network and another, enabling call traffic to be conveyed from one network to another.
 - b) Wholesale call termination (WCT): This is the completion of a call by a network from a customer of another network.
 - c) BT's End-to-End Connectivity Condition: as noted above, BT is subject to a specific access condition requiring it to purchase wholesale call termination services as soon as reasonably practicable and on reasonable terms and conditions, including charges.
- 2.12 The relationship between End-to-End connectivity, interconnection and call termination is illustrated in Figure 2.1 below. Telecoms providers interconnect their networks to pass calls between their customers, allowing these calls to be terminated, or received, on

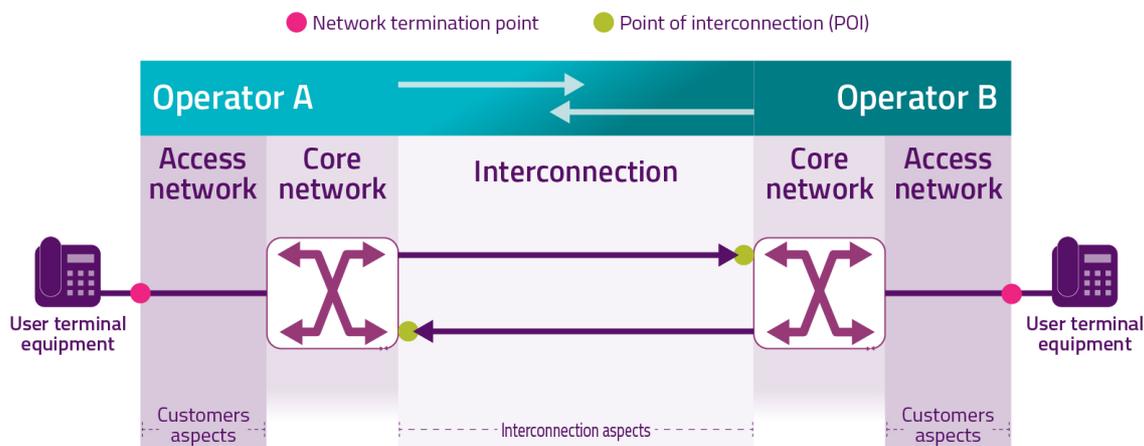
⁶ <https://www.openreach.co.uk/orgp/home/products/wlrwithdrawal/wlrwithdrawal.do>

⁷ Such a network effect could give rise to a 'winner takes all' outcome, as the largest provider may become dominant to the exclusion of smaller providers unless the terms on which providers' networks interconnect promote fair competition for customers, support innovation and investment in services, and protect customers from harm, such as unreasonable prices.

⁸ End-to-end connectivity is defined in Section 74(3) of the Communications Act as the facility – "(a) for different users of the same public electronic communications service to be able to communicate with each other; and (b) for the end-users of different such services to be able, each using the service of which he is the end-user, to communicate with each other".

customers' phones. Interconnection and termination are necessary for the achievement of End-to-End connectivity.

Figure 2.1: Interconnection and termination



Source: Ofcom.

Wholesale call termination on TDM networks

2.13 Fixed line TDM networks are dedicated networks whose principal function is to connect telephone calls. They have distinct switching elements, typically comprising:

- local exchange elements – switching elements to which customer lines are directly or indirectly connected, and which provide call origination, call termination and local switching functions for those customers; and
- tandem switching elements – larger networks generally have additional switching elements which connect calls between local exchange elements.

2.14 WCT is made available at the local exchange elements as these are the closest point to end-users' telephone lines where access can be provided.

2.15 In BT's network the local exchange elements are its over 600 Digital Local Exchanges (DLEs) located around the UK. Other telecoms providers wishing to access WCT for all lines on BT's network must interconnect at each of BT's DLEs. Alternatively, telecoms providers can reduce their network requirements by interconnecting at the tandem layer of BT's network, in which case, BT also provides additional tandem switching and conveyance services to deliver calls to the DLEs. At present, BT provides these services on a commercial basis.

Wholesale call termination on IP networks

2.16 In contrast to TDM networks, IP networks are multipurpose networks which provide data services such as broadband internet access as well as telephony. Unlike TDM networks, they do not have dedicated switching functions to connect calls. Instead, calls are encoded

as IP packets and conveyed across a common IP network infrastructure that is used for all services.⁹

2.17 IP network architecture differs from TDM networks in two other important respects that are relevant to our consideration of interconnection and WCT:

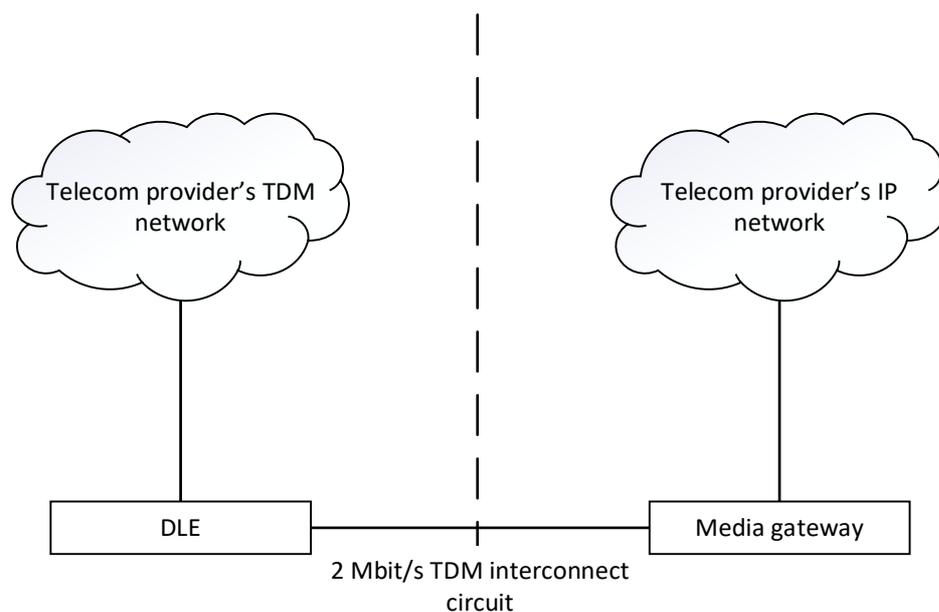
- IP networks usually only have a small number of Points of Interconnection (POI) located at core network nodes which are remote from most end-users' fixed lines.
- Call conveyance costs are generally considered not to be strongly distance dependent because telephony traffic is usually a tiny fraction of the overall volume of data traffic carried by the network.

2.18 Consequently, some telecoms providers make WCT available at multiple POIs.

Interconnection between TDM and IP networks

2.19 TDM and IP networks use different communications protocols and data formats for call control and transport. Translation is therefore required to facilitate interconnection between TDM and IP networks, adding to the cost of interconnection. This translation is carried out by equipment called a media gateway as illustrated in Figure 2.2 below.

Figure 2.2: TDM interconnection between a TDM network and an IP network



Source: Ofcom.

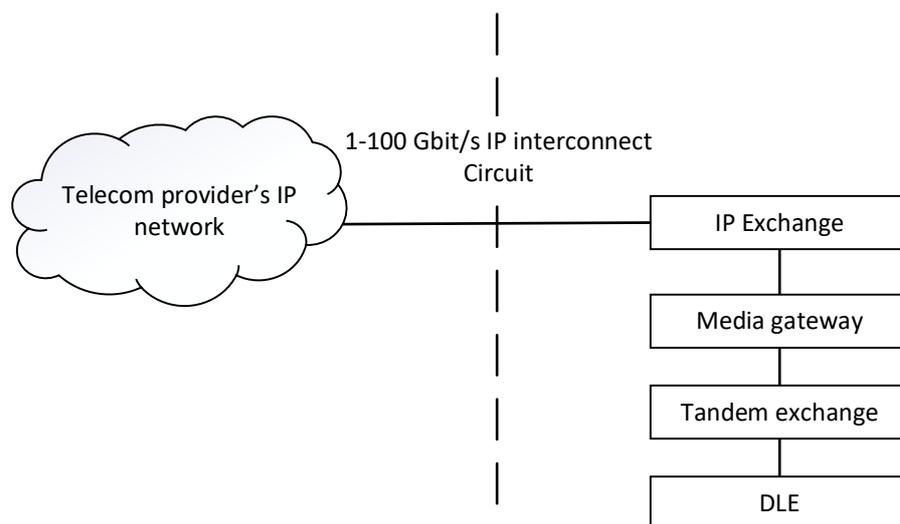
2.20 Telecoms providers with IP networks wishing to obtain WCT on BT's TDM network can either:

- deploy media gateways and obtain TDM interconnection at each of BT's DLEs; or

⁹ Telephone services are controlled by network elements known as call servers which are responsible for call setup and clear-down. These network elements typically serve large numbers of end-users and are located at the core of the network, remote from most end-users' fixed lines.

- Use BT's IP Exchange (IPEX) product to obtain IP interconnection, in which case BT provides the media gateways, tandem switching and inter-tandem conveyance required to access WCT as illustrated in Figure 2.3 below. Currently, BT provides these additional services on a commercial basis.

Figure 2.3: IP interconnection to BT's TDM network



Source: Ofcom.

BT's migration process

- 2.21 As noted above, Openreach plans to withdraw WLR services by 2025 in preparation for the withdrawal of BT's TDM Network. We understand that BT is still developing its own migration plans (for its own telephone services and its interconnections with other networks).
- 2.22 For interconnection purposes, calls would continue to be routed between networks on the basis of number block allocations.¹⁰ BT's numbers would therefore also need to be transferred on a number block basis. After BT and other telecoms providers have made the necessary preparations, BT would transfer the number block and associated telephone services to its IP network. Other telecoms providers would then reconfigure their networks to route calls to the IP network.

Market trends

- 2.23 This section outlines broad trends in the voice telephony market over the last twenty years, as well as more recent trends relevant to our regulation of call termination and interconnection.

¹⁰ Telecoms providers obtain telephone numbers from Ofcom in blocks (generally of 10,000 or 1,000 numbers). These blocks are also used for call routing for interconnection purposes. For each number block, the telecoms provider holding the block specifies where WCT may be obtained. On BT's TDM network, each number block is associated with a particular DLE.

Trends in the voice telephony market

- 2.24 The market for voice calls has changed dramatically over the last twenty years. Prices have fallen, technology has developed significantly, and most importantly perhaps, use of fixed telephony (and of fixed and mobile combined) has declined. Despite this decline in use, telephony remains an important service with more than 200 billion of minutes of calls a year made in the UK which generates revenues for industry of more than £3bn.
- 2.25 Call prices for both fixed and mobile have fallen dramatically. Historically, prices for fixed line calls depended on the geographic location of the caller and the number of the call recipient, while mobile calls were typically more expensive. Today, most calls from both landlines and mobiles are included in call allowances, and data allowances matter more to retail service pricing than call allowances.¹¹ Calls made outside these allowances, however, can lead to unexpectedly high bills.¹²
- 2.26 Technological advancements have enabled alternatives to fixed line telephony to emerge. The development and prolific adoption of mobile and, more recently, the smartphone has likely been a key driver in the decline of fixed line call volumes.¹³ While fixed voice quality on the PSTN has remained largely unchanged, mobile call quality has improved, as ‘HD Voice’ calling is now available on all major UK mobile networks.
- 2.27 In addition, the emergence of OTT VoIP services and social media platforms have likely reduced the use of fixed line call services.¹⁴ Most of these platforms offer their services to users without charge and tend to operate as ‘closed networks’, only allowing users to contact other users of the same platform. Closed networks do not contribute to the general ‘end-to-end’ network effect as PSTN telephony has traditionally done, but these platforms have been successful as users have increasingly switched to smartphones and other connected devices.
- 2.28 Despite falling call volumes, revenues earned from fixed voice telephony remain substantial; UK fixed voice service revenues were £1.9bn in the year to Q3 2018.¹⁵ In comparison, the revenue earned from the provision of regulated services, such as interconnection and termination, appear small; BT earned £6 million from its provision of DLE interconnection and £7 million from its provision of fixed geographic termination in 2017/2018.¹⁶
- 2.29 However, regulation of interconnection and call termination is important in setting the conditions for competition that underpin the wider retail market. Regulated pricing provides a constraint on other unregulated commercially negotiated prices, such as transit

¹¹ Ofcom, 2018. *Pricing trends for communications services in the UK*, p. 14.

https://www.ofcom.org.uk/data/assets/pdf_file/0030/113898/pricing-report-2018.pdf

¹² Ofcom, 2018. *Pricing trends for communications services in the UK*, pp. 10-11.

¹³ Ofcom, 2018. *Communications Market Report*, Section 4.2.

¹⁴ Ofcom, 2018, *Communications Market Report*, Section 4.2.

¹⁵ Ofcom, *Telecommunications Market Update Q3 2018*, pp. 1, 4-5, <https://www.ofcom.org.uk/research-and-data/telecoms-research/data-updates/telecommunications-market-data-update-q3-2018>

¹⁶ BT, *Regulatory Financial Statements 2018*, p. 22

<https://www.btplc.com/Thegroup/Policyandregulation/Governance/Financialstatements/index.htm>

prices. As such, the regulated pricing of interconnection and call termination ultimately underpin the economics of the retail voice market.

Trends affecting call termination

2.30 In addition to the market trends set out above, we consider the following trends and factors to be relevant to our regulation of call termination:

- the development of OTT VoIP services offering the ability to make calls that terminate on telephony, but do not offer the ability to terminate calls from telephony on the OTT VoIP service. We refer to this as ‘one-way calling’;
- the increasing convergence of mobile and fixed voice services both in the eyes of customers, as more and more mobile networks offer Wi-Fi calling, and at a network level, as we move towards a single IP core which supports both fixed and mobile calls;
- growing concern about arbitrage and the artificial inflation of traffic (AIT)¹⁷; and
- the specification in Article 75 of the European Electronic Communications Code (EECC) that fixed and mobile termination rates will be set by the Commission from 2021.

2.31 Ahead of our next market review of fixed and mobile termination rates, we have an opportunity to consider our approach to call termination regulation. In Section 7, we provide further detail on these developments and the possible implications for our regulation of termination, as well as the regulatory options available to us in future reviews.

Structure of document

2.32 We are now considering the implications of the move to IP-based networks and the trends outlined above for our regulation of interconnection, call termination and End-to-End connectivity. The rest of this document is set out as follows:

- Section 3 sets out the economic rationale for our existing regulation of call termination and interconnection;
- Section 4 sets out some potential options for regulation during the migration to IP networks and factors we propose to consider in evaluating those options;
- Section 5 outlines the potential changes to BT’s end-to-end connectivity obligation, given that its role in interconnection and transit provision is likely to change as we move to an all-IP world.
- Section 6 discusses the issue of technical standardisation of IP-based interconnection, given the potential risks to call quality and integrity.
- Section 7 considers the future regulation of call termination ahead of our next review of the relevant markets, in light of the trends briefly outlined above.

¹⁷ AIT is a BT contractual term relating to telephony traffic which is fraudulent or has no legitimate commercial purpose.

3. Current regulation

- 3.1 In this section we outline why we regulate fixed and mobile call termination, and interconnection between fixed voice networks, as well as how we do so.

Call termination

Rationale for regulating fixed and mobile call termination

- 3.2 In the Narrowband Market Review (NMR) 2017 and Mobile Call Termination (MCT) 2018 market reviews we defined wholesale markets for termination of calls to UK fixed geographic numbers (wholesale call termination, or WCT) and mobile numbers (mobile call termination, or MCT). We considered the potential for demand-side and supply-side substitution at both the retail and wholesale levels but found it to be insufficiently strong to widen our market definitions. Consequently, we defined 285 separate markets for WCT¹⁸, and 67 for MCT¹⁹, corresponding to each of the operators providing termination services.
- 3.3 We then assessed whether each telecoms provider was able to act, to an appreciable extent, independently of competition, customers, and ultimately consumers. Finding that they were, we concluded that each telecoms provider has SMP with respect to its corresponding relevant market.
- 3.4 In making our decisions on remedies we had two primary concerns about how providers could behave as a result of their SMP: refusing access and excessive charging. We designed our remedies accordingly, as explained below.

How we regulate call termination

Overview

- 3.5 Providers of WCT and MCT are currently subject to charge controls, in addition to obligations requiring them to provide access to these services on fair and reasonable terms. BT's provision of WCT is also subject to four additional regulatory obligations: to not unduly discriminate, to publish a Reference Offer, to undertake accounting separation and cost accounting.²⁰

¹⁸ Ofcom, 2017. *Narrowband Market Review: Statement - Markets, market power determinations and remedies for wholesale call termination, wholesale call origination and wholesale narrowband access markets*, paragraph 12.45. https://www.ofcom.org.uk/data/assets/pdf_file/0020/108353/final-statement-narrowband-market-review.pdf

¹⁹ Ofcom, 2018. *Mobile Call Termination Market Review 2018-2021 – Final Statement*, paragraph 3.89. https://www.ofcom.org.uk/data/assets/pdf_file/0021/112458/Final-Statement-Mobile-Call-Termination-Market-Review-2018-2021.pdf

²⁰ Ofcom, 2017. *Narrowband Market Review: Statement*, section 1, Table 1.5.

3.6 The charge controls on WCT and MCT markets are single flat rate maximum caps based on a long-run incremental cost (LRIC) standard to support competition between providers and prevent excessive pricing in call termination rates.²¹

Application of the regulated fixed termination rate

3.7 The fixed call termination service is defined as: “the conveyance of all signals (including relevant control signals) required to terminate calls to a customer from the point in the network closest to the end customer’s point of connection to the network where those signals can be accessed by another [telecoms provider].”²²

3.8 As explained, above, charges for fixed call termination services are regulated. We refer to this charge as the regulated fixed termination rate (FTR). The regulation applying to the FTR is technology-neutral, meaning that it applies to both TDM and IP networks.²³ However, the point at which the regulated FTR applies is different according to whether the fixed call termination service is provided in respect of a number residing on the terminating provider’s TDM network or on its IP network.²⁴ As a result an originating provider seeking to route a call to:

- a number hosted on another telecom provider’s TDM network is charged the regulated FTR if it interconnects with that telecoms provider at the switching element closest to the number called (in BT’s network the DLE to which the end-users line is connected);
- a number hosted on another telecoms provider’s IP network is charged the FTR if it interconnects with that telecoms provider’s IP network at the POI(s) that the telecoms provider designates as the relevant POI for which the FTR should apply.²⁵

3.9 If an originating provider chooses to interconnect with a terminating provider in any other way or elsewhere in the network, commercial agreement is required for additional switching and conveyance services. For example, if the originator chooses to interconnect with BT’s TDM network at the tandem level rather than the DLE, BT may levy a commercially negotiated conveyance charge to route its traffic to the relevant DLE (in addition to the FTR from that point). Alternatively, the originating provider may commercially contract with a transit provider to route its traffic to the relevant DLE and so would pay transit costs in addition to the FTR.

3.10 Where an originating provider with an IP network chooses to interconnect with a TDM network such as BT, it has options as to how to achieve this. If the originator chooses to interconnect via BT’s IPEX platform it will require, in addition to the termination service, media conversion and conveyance which would have to be commercially negotiated.

²¹ LRIC are those costs which are caused by the provision of a defined increment or service – i.e. those costs that would not be incurred if that service was longer provided, while all other services and products are still provided.

²² Ofcom, 2017. *Narrowband Market Review: Statement*, paragraph 12.3.

²³ Ofcom, 2017. *Narrowband Market Review: Statement*, footnote 561.

²⁴ The network access condition should be interpreted as requiring a hosted telecoms provider to ensure its numbers can be reached via at least one POI at the regulated termination rate. 2017 NMR, paragraph 13.46.

²⁵ As noted above in Section 2, given that call conveyance costs are generally considered not to be strongly distance dependent on an IP network, some telecoms providers choose to make WCT, and therefore the FTR, available at multiple POIs.

Alternatively, it could provide media conversion itself and route the call to BT's DLE, or commercially contract with a transit provider to do this.

Application of the regulated mobile call termination rate

- 3.11 At the wholesale level, MCT services are accessed by an originating provider at a handover point on the terminating provider's network. Given the inherently non-geographic nature of mobiles services our understanding is that on a given mobile network, the handover points provide connection to all the UK mobile numbers hosted on that network, so MCT is available at all core nodes.
- 3.12 Furthermore, our understanding is that, unlike fixed telephony, the conveyance of all voice traffic on mobile operators' core networks is already IP-based.

Interconnection

Rationale for regulating interconnection

- 3.13 In the 2017 NMR, interconnection is defined as the linking (whether directly or indirectly by physical or logical means) of one network and another, enabling end-users of different networks to communicate with one another and to access services provided on a different network.²⁶
- 3.14 In the 2017 NMR we found that BT had SMP in the provision of WCO and WCT in the UK excluding the Hull area. We concluded that BT was able to exercise the SMP it holds in relation to WCT and WCO through the pricing and/or provision of interconnection to these services since:²⁷
- BT's SMP in WCO would allow it to discriminate against competing providers seeking interconnection to this service.
 - BT has a large customer base served by a very distributed set of terminating nodes. This means that providers interconnecting with BT for WCO and WCT services need to connect to more than 600 DLEs.
- 3.15 As a result, we decided that access to the circuits required to reach the terminating (and originating nodes) on the BT network should be regulated.²⁸
- 3.16 Similarly, we found that KCOM had SMP in WCO and WCT in the Hull area. We concluded that KCOM had the incentive and ability to refuse access to (or price excessively for) the nodes connecting its customers' access lines over which it is required to provide WCO. However, we said that KCOM would be less likely to effectively leverage SMP in WCT into the provision of interconnection circuits (relative to BT). This is because KCOM has a much

²⁶ Ofcom, 2017. *Narrowband Market Review: Statement, annex 2*, https://www.ofcom.org.uk/data/assets/pdf_file/0021/108354/final-statement-narrowband-market-review-annexes-1-8.pdf.

²⁷ Ofcom, 2017. *Narrowband Market Review: Statement*, paragraphs 17.109 and 18.44

²⁸ Ofcom, 2017. *Narrowband Market Review: Statement*, paragraphs 17.109-17.111.

smaller network of subscribers, and has far fewer terminating nodes than BT. We therefore decided to impose remedies requiring KCOM to provide access to its interconnection circuits on fair and reasonable terms, and related conditions, but we did not impose a charge control on access to its interconnection circuits.²⁹

- 3.17 While we recognised that providers other than BT and KCOM had SMP in WCT, we did not impose regulation on their interconnection circuits beyond General Condition A1 which requires network providers to negotiate interconnection on request (see below). We said that a competitive distortion requiring further *ex ante* intervention was less likely to arise in the provision of interconnection where providers were of a similar size and subject to the same regulatory obligations.³⁰

How we regulate interconnection

Overview of interconnection regulation

- 3.18 In Table 3.1 below we summarise the regulation and remedies currently imposed on voice interconnection. Notable features are that:
- all network providers are obliged to negotiate interconnection on request, under on General Condition A1 (GC A1).³¹
 - we regulate access to TDM circuits interconnecting with BT's DLEs. The remedies we have imposed include a charge control of the TDM interconnection circuits at BT's DLEs, currently set to keep them constant in real terms (i.e. a CPI+0% cap from the previous level);³²
 - we regulate access to TDM circuits interconnecting to KCOM's fixed voice network in the Hull Area. The remedies we have imposed include an obligation to provide access on fair and reasonable terms;³³ and
 - we decided not to regulate interconnection to BT and KCOM's fixed voice IP networks in the 2017 NMR.³⁴

²⁹ Ofcom, 2017. *Narrowband Market Review: Statement*, paragraphs 17.112-17.113 and Section 18 (in particular, Table 18.1).

³⁰ Ofcom, 2017. *Narrowband Market Review: Statement*, paragraphs 17.114-17.115.

³¹ As set out in Ofcom's General Conditions of Entitlement, <https://www.ofcom.org.uk/phones-telecoms-and-internet/information-for-industry/telecoms-competition-regulation/general-conditions-of-entitlement>. Further to this General Condition A3 aims to ensure the fullest possible availability of public communications services, including access to emergency services.

³² Ofcom, 2017. *Narrowband Market Review: Statement*, paragraphs 19.3 and 19.46-19.47

³³ Ofcom, 2017. *Narrowband Market Review: Statement*, Table 18.1.

³⁴ Ofcom, 2017. *Narrowband Market Review: Statement*, paragraphs 17.91 and footnote 771.

Table 3.1: Overview of current regulation of interconnection for fixed and mobile voice

Current regulation	TDM fixed voice at DLEs			IP voice	Mobile
	BT	KCOM	Others	All CPs	All CPs
GC A1 requires network providers to negotiate interconnection on request	√	√	√	√	√
Provide access on reasonable request	√	√			
Charge control on DLE interconnection	√				
Requirement not to unduly discriminate	√				
Publish a reference offer	√	√			
Notify changes to charges	√	√			
Accounting separation	√				
Cost accounting	√				
Transparency as to quality of service	√				

Source: Ofcom.

No regulation of IP interconnection

- 3.19 Although we recognised in the 2017 NMR that regulation might be extended to IP interconnection in the future, we only imposed a charge control on TDM interconnection at BT's DLEs.³⁵ We said that TDM remained an efficient technology choice for BT at the time, and as such our regulation ought to ensure access to this technology.³⁶ We also said that the charge control on BT's TDM interconnection provides a degree of constraint on commercial agreements regarding IP interconnection.³⁷
- 3.20 Providers with IP networks tended to disagree with this approach and called for us to regulate BT's IPEX service.³⁸ In response, we said that we did not think that migration to IP would progress sufficiently within the period of the review for the charge control on BT's TDM interconnection circuits to no longer provide a constraint on commercial negotiations regarding IP interconnection.³⁹
- 3.21 That said, we noted the options we had to intervene if the extent of IP migration during the review period meant that the charge control on BT's TDM interconnection rates was no

³⁵ Ofcom, 2017. *Narrowband Market Review: Statement*, Section 17.

³⁶ Ofcom, 2017. *Narrowband Market Review: Statement*, paragraphs 17.34-17.36 and 17.46-17.53.

³⁷ Ofcom, 2017. *Narrowband Market Review: Statement*, paragraphs 17.87

³⁸ Ofcom, 2017. *Narrowband Market Review: Statement*, paragraphs 17.27-17.33, 17.70-17.74 and 17.79-17.81

³⁹ Ofcom, 2017. *Narrowband Market Review: Statement*, paragraphs 17.90.

longer an effective constraint on IP interconnection charges. This included starting the next market review early or using our Competition Act powers.⁴⁰

- 3.22 We do not at this stage consider it necessary to conduct the next market review early or to use our Competition Act powers. However, given the scale of the migration that the industry is about to embark upon, we do see merit in setting out potential options for regulation ahead of the next review.

⁴⁰ Ofcom. *2017 Narrowband Market Review: Statement*, paragraphs 17.92-17.94.

4. Regulation during migration to IP

- 4.1 As explained in Section 3, we regulate the provision of fixed call termination to geographic numbers, including by imposing a charge control for access to these services (the FTR). BT also has regulatory obligations in relation to the provision of TDM interconnection circuits, which include a charge control. In this section, we discuss how the migration from TDM technology to IP by BT may impact the case for regulation and if so, alternative regulatory options we may consider in the next market review. We address other aspects of future fixed and mobile termination regulation, such as the impact of the EECC and the appropriate cost standard, in Section 7.
- 4.2 In considering the regulatory options, we have had regard to our regulatory objectives, including in particular encouraging the provision of network access and service interoperability, efficiency and sustainable competition, efficient investment and innovation, and the maximum benefit for customers.⁴¹ In particular, we want to enable providers to make efficient technology choices (as well as associated investment decisions), minimise the cost of migration and avoid potential for disruption to services.
- 4.3 We look first at where fixed call termination should be regulated as number blocks are migrated to IP networks, and then consider the regulatory options in respect of access to BT's interconnection circuits.
- 4.4 We focus our discussion on BT, the largest provider of fixed voice services. All fixed network providers are subject to similar obligations in respect of fixed call termination; KCOM is required to provide access to its interconnection circuits on fair and reasonable terms. We do not consider directly the impact of IP migration on the regulation of these providers but note that similar considerations may apply in some cases. The issues we consider relate to BT but in subsequent consultation we will explore in more detail the implications for other providers.

Call termination regulation

Current approach to regulation

- 4.5 As set out in Section 3, whether an originating provider is charged the FTR or more depends on whether it interconnects with the terminating provider at the appropriate POI.
- 4.6 The appropriate POI will depend on whether BT has designated the geographic number block being called as residing on its TDM or IP network. For calls made to numbers residing on BT's TDM network, the appropriate POI is the DLE closest to the end-user. Where the call is handed over at this POI for termination, the FTR is charged. If an originating provider does not interconnect at the relevant DLE, BT is able to charge commercial rates for the

⁴¹ Section 4(7) and (8), Communications Act 2003

additional switching and conveyance services necessary to route the calls to the DLE, as well as for media conversion if IP interconnection is used.

- 4.7 Where BT has designated a geographic number block as residing on its IP network, it is required to make available at least one POI to its IP network where only the FTR is charged.

Impact of IP migration on the current approach to the regulation of termination services

- 4.8 In line with the objectives of encouraging network access, we are concerned to ensure that BT's migration of its geographic number blocks to an all IP network does not give it an opportunity to charge providers excessive fees for switching, conveyance and media conversion. This could distort competition, and lead to incentives for both BT and other providers to sustain investments in TDM assets longer than they would otherwise choose to do. This could potentially cause inefficiencies, as well as delay any benefits from innovation and quality that migration to all IP networks could bring.
- 4.9 If this concern is plausible, we may need to adjust our current approach to regulating access to BT's termination services during and after IP migration.

Increased charges for routing calls via IP networks to numbers residing on TDM networks

- 4.10 Currently, when an originating provider with an IP network chooses to route a call to a number residing on BT's TDM network via BT's IP network, it has to pay for media conversion as well as switching and conveyance of the call to the relevant DLE. BT currently charges commercially negotiated rates for these services. Alternatively, if the originating provider opts to route the call using its own TDM assets to interconnect at the relevant DLE, it will only have to pay the FTR.
- 4.11 The originating provider's option to interconnect directly at the DLE provides a constraint on BT's charges for switching, conveyance and media conversion services required when IP interconnection is used. Similarly, use of transit services from another provider to route a call directly to the relevant DLE should constrain the commercial price BT can set for these services.
- 4.12 However, these constraints are only available if providers retain the TDM assets needed to route traffic to the DLE. As BT migrates its numbers from its TDM network to its IP network, it is likely that originating providers will want to dispense with their TDM assets. This is because the ongoing cost of maintaining these TDM links will be harder to justify given the approaching redundancy of TDM assets once BT fully migrates to an all IP network.
- 4.13 At the same time, to the extent that originating providers with IP networks route calls destined for numbers residing on BT's TDM network via BT's IP network, BT will incur capital costs of equipment to provide conversion capacity and the ongoing operating costs of that equipment. A proportion of these costs are 'sunk' and the equipment may become obsolete once migration to IP is complete and no further conversion is required.

- 4.14 If BT migrates its network in an orderly and predictable manner, originating providers should be able to restructure their networks and dismantle their TDM assets at a similar pace to BT, enabling them to minimise the need to purchase switching, conveyance and media conversion from BT for calls to numbers still residing on BT's TDM network.
- 4.15 However, issues could arise if BT's migration is unpredictable. For example, if BT's migration takes longer than expected, there is the risk that competitors will retain their TDM interconnection assets longer than anticipated. Alternatively, originating providers may prematurely dismantle their TDM assets so that they are no longer able to interconnect directly to the relevant DLE (and access the FTR). In doing so, the constraint on BT's charges for conveyance and media conversion services may be weakened, enabling BT to charge higher rates for these services during the migration period.
- 4.16 Ensuring that there is transparency about when BT's number blocks are likely to be migrated to its IP network may therefore play an important role in allowing competitors to align their network assets with the progress of BT's IP migration, and exercise greater control of conveyance and media conversion costs.

Question 4.1: Do you agree that if BT's migration to an IP network is unpredictable, it could result in increased charges for providers routing calls to its network? Are there any other issues that might arise as a result of its migration?

Options for regulation in the future

- 4.17 We set out below regulatory options which we identified as potentially appropriate for supporting efficient migration.

Supporting efficient migration

- 4.18 The risk of originating providers facing excessive charges for media conversion, switching and conveyance could be mitigated by measures to ensure that BT communicates its migration timetable in advance, that BT migrates at an efficient pace and that the scope for originating providers to be overcharged is reduced. Potential regulatory options include:
- 1) **Timetable** – Requiring BT to set out a timetable, within a specified time period after the commencement of the market review period in April 2021, which identifies when each number block will be migrated to IP for interconnection purposes and when the FTR will be available at an IP POI for each number block. This should provide other providers with certainty, enabling them to align the restructure of their networks with the pace of BT migration, minimising the amount of conveyance and media conversion required.
 - 2) **Mandated pace of migration** – We could consider the extent to which it would be appropriate to specify parameters for the pace of BT's migration of its number blocks to its IP network for interconnection purposes. For example, such an approach could involve setting milestones for the migration by BT of its number blocks to its IP network, and require it to complete its migration within a specified timeframe. Such an

approach would reduce the prospect of BT adopting a migration timetable that is unduly long, which could result in originating providers making inefficient technology choices or incurring excessive media conversion and conveyance costs.

- 3) **FTR at the DLE and at an IP POI** - Requiring BT to offer the regulated FTR for each number block at both the DLE and on its IP network simultaneously for a specified time period following the re-designation of that number block to its IP network, for the purposes of interconnection.

- 4.19 Options 2 and 3 would most likely be implemented in combination with the obligation for BT to publish a timetable for its migration to IP (i.e. option 1).

Question 4.2: Please state which of these measures you consider would be appropriate for securing efficient migration and why?

Regulate charges for media conversion, switching and conveyance to numbers residing on TDM networks, routed via IP networks

- 4.20 Alternatively, it might be appropriate to regulate BT's charges for media conversion, switching and conveyance to originating providers that interconnect with its IP network in order to route calls to numbers residing on its TDM network.

- 4.21 These regulated charges could take account of the likely costs and volumes of conversion, switching and conveyance. Furthermore, the regulated rates could gradually reduce over time, in order to promote a more efficient migration.

Question 4.3: Would the regulation of charges for media conversion, switching and conveyance for calls routed via IP networks be an effective means of preventing excessive charges and promoting an efficient migration to IP?

Providers' ability to designate the POI on their IP network at which the FTR should apply

- 4.22 As noted in Section 3, if a number block resides on a telecoms provider's IP network, the telecoms provider is required to make available at least one POI to its IP network where only the FTR is charged. A telecoms provider is able to nominate any of the POIs on its IP network as the POI where only the FTR applies. Because call conveyance costs are generally considered not to be strongly distance dependent on an IP network, some telecoms providers have chosen to make the FTR available at multiple POIs.

- 4.23 Once BT and the other major telecom providers migrate to all IP networks, we consider that it remains appropriate that all telecoms providers maintain their discretion to designate a single POI at which only the FTR applies. However, we are interested to know if stakeholders have any concerns about this approach.

Question 4.4: Do you agree that it remains appropriate that telecoms providers maintain their discretion to designate a single POI at which the FTR will apply?

Interconnection regulation

Current approach to regulation

- 4.24 Under General Condition A1, all providers are required to negotiate interconnection on request. In addition, we regulate access to TDM circuits interconnecting with BT's DLEs, but we do not regulate TDM circuits interconnecting with BT's tandem switches or interconnection to BT's IP network.
- 4.25 In the 2017 NMR, we recognised that regulation might need to be extended to IP interconnection circuits as BT migrates number blocks to IP for the purposes of call termination.⁴²

Concerns in relation to this current approach

- 4.26 We expect that each of the factors explained in Section 3 that caused us to impose regulation on BT's TDM interconnection will either change or no longer be present in the future, either directly as a result of the migration to IP or because of other market trends.
- 4.27 First, once migration to IP is complete, providers will be able to originate fixed voice calls using IP technology over broadband. As such, competitors will no longer be required to purchase wholesale call origination from BT, which in turn could remove BT's SMP in WCO. Were BT to not have SMP in WCO, we would no longer be concerned that it is able to discriminate against competing providers seeking access to WCO by setting unfavourable terms for interconnection.
- 4.28 Second, migration to IP implies that interconnection occurs at far fewer points. For its TDM network, BT has more than 600 points of interconnection at its DLEs and more than 80 at its tandem switches. In contrast, BT's IP network has far fewer points of interconnection, of which only a subset would typically be used to interconnect with another large network. Interconnection costs to BT's IP network are therefore likely to be significantly lower than on TDM, reducing the ability BT has to leverage its SMP in WCO and WCT into interconnection to its network.
- 4.29 Separately, we note that BT's position as the main terminating provider for fixed voice calls may weaken in the future. To the extent that migration to IP would promote competition in the transit market due to lower interconnection costs, BT's current position as the more efficient host of smaller providers could be weakened. Moreover, any introduction of a common numbering database could support direct routing of calls to ported numbers. This would reduce BT's share of interconnection traffic relative to the current situation, where it onward routes a significant volume of traffic for numbers that are ported out to other

⁴² Ofcom, 2017. *Narrowband Market Review: Statement*, paragraphs 17.85 - 17.94.

providers. In turn, this would reduce the imbalance in scale between BT and other providers in relation to termination, which should further reduce any ability BT may hold to overcharge for its interconnection services.

4.30 These changes may imply that it would not be necessary to regulate interconnection circuits to BT's IP network in the long run.

4.31 Nonetheless, during migration these changes may not have fully played out. BT may retain SMP in WCO during the next review period and, as the largest holder of geographic numbers, it is likely to remain the main terminating provider. Moreover, for termination to numbers which have not yet been re-designated from BT's TDM network to its IP network, telecoms providers will have to interconnect at BT's over 600 DLEs to access the regulated FTR.

Question 4.5: Do you agree with our assessment about how BT's market position in relation to interconnection might change during migration to IP?

Potential options for regulation

4.32 Once migration to IP is complete, our preliminary view is that it is unlikely that there will be a need to regulate interconnection circuits to BT's IP network.

4.33 During migration to IP, our preliminary view is that we should retain current regulation of TDM interconnection circuits at BT's DLEs.

4.34 Given that interconnection to BT's IP network will occur at far fewer points than is the case for TDM, and the potential for migration to IP to undermine BT's SMP in WCO, at this stage we are not minded to extend the regulation to apply to BT's IP interconnection circuits during migration.

Question 4.6: Do you agree that there is unlikely to be a need to impose regulation on BT's interconnection circuits once migration to IP is complete?

Question 4.7: Do you agree that we should continue to regulate BT's TDM interconnection circuits as the industry migrates from TDM to IP based networks?

Question 4.8: Do you agree that it would not be necessary to impose regulation on interconnection circuits at BT's IP network during migration?

5. Approach to E2E connectivity

- 5.1 We intend to review the need for BT's End-to-End Connectivity Condition as part of the forthcoming market review. We have set out our initial views below and would welcome contributions from stakeholders.

Introduction

- 5.2 As explained in Section 2, end-to-end connectivity means the facility for users of retail telephone services to call all other telephone users on their provider's network and those on all other providers' networks. This is important to end-users and for competition. End-users expect to be able to call any telephone number and telecoms providers need to be able to interconnect with other networks to provide this service to their customers.
- 5.3 This connectivity is supported by regulatory obligations imposed on telecoms providers. General Condition A1.2 requires network providers to negotiate on request interconnection agreements in order that end users can communicate with one another. General Condition B4.2 requires all telecoms providers to ensure that end-users can access all telephone numbers in the European Union (included UK numbers in the National Telephone Numbering Plan), where technically and economically feasible.
- 5.4 In addition, BT is subject to a specific access condition, the End-to-End (E2E) Condition, under sections 73 and 74 of the Communications Act 2003. This requires BT to purchase wholesale call termination services as soon as reasonably practicable and on reasonable terms and conditions, including charges.
- 5.5 Although the E2E Condition does not impose any obligations in relation to transit services, its scope (specifically its application solely to BT rather than to all telecoms providers) reflects BT's prominent position in the provision of transit services when the condition was imposed in 2006. In practical and commercial terms, once a telecoms provider had secured an agreement to send calls to BT's network, it was able to send calls to all other networks using BT's transit services.
- 5.6 The E2E Condition is designed to address the risk that BT might not have sufficient incentives to ensure end-to-end connectivity, in particular in relation to small providers such as new entrants, in part because the lack of interconnection with a small provider would not have an appreciable impact on customers' perceptions of end-to-end connectivity. BT might not for example purchase call termination from a new market entrant or conclude an agreement within a reasonable period. As a result, the new entrant's customers would not be able to be connected to other BT customers with a fixed line or, if intending to use BT's transit for connectivity to other networks, would not be able to be connected to any other customers.

BT's role in the provision of connectivity

- 5.7 Much has changed since the E2E Condition was imposed in 2006. Whilst BT remains the largest provider of transit services and has the most direct interconnections with other networks, other telecoms providers also provide transit services and BT does not have direct interconnection with a significant minority of networks. In recent narrowband market reviews, we have withdrawn ex-ante regulation of transit services.
- 5.8 The transition from TDM to IP networks may lead to further changes in the pattern of interconnection between networks, for example by making call routing more flexible, and by reducing the cost of interconnection, thereby reducing the barrier to direct interconnection between networks.
- 5.9 Our initial view is that BT's role as transit provider may now be less central to the achievement of end-to-end connectivity and consequently the concerns about BT's incentives (particularly in relation to small providers, which led to the imposition of the E2E Condition) may be reduced. BT's role may also become less important following the transition to IP networks. Telecoms providers, including new entrants, have a choice of large telecoms providers offering transit services with whom they can interconnect to gain access to call termination services on other networks; and to make their own call termination services generally available to other networks.

Need for supplementary obligations to support end-to-end connectivity

- 5.10 Our initial view is that the case for the E2E Condition appears weaker now that BT's role is less central to end-to-end connectivity and telecoms providers have a choice of transit providers with whom they can interconnect. Moreover, the E2E Condition tends to reinforce BT's role as the main transit hub for the UK telephone system potentially hindering the development of competition in transit services.
- 5.11 These same factors suggest that access obligations requiring telecoms providers to purchase call termination in support of end-to-end connectivity (whether applicable to BT or telecoms providers more generally) may no longer be required. Telecoms providers have a greater choice of interconnection partners, all of whom are subject to General Condition A1. This obliges telecoms providers operating public electronic communications networks to negotiate interconnection with a view to completing an agreement within a reasonable period. Our initial view is that General Condition A1 may be sufficient to ensure that telecoms providers can obtain interconnection and that additional access conditions may no longer be required to ensure end-to-end connectivity.

Question 5.1: Do you agree that BT's role is less central to the provision of end-to-end connectivity and that telecoms providers now have a choice of transit providers with whom they can interconnect?

Question 5.2: How might the transition to IP networks change the pattern of interconnection and how might this affect how E2E connectivity is achieved?

Question 5.3: Do you agree that General Condition A1 is sufficient to ensure that telecoms providers can obtain interconnection and that additional access obligations may no longer be required to ensure end-to-end connectivity? If not, please explain why and what obligations you think are necessary.

6. Technical standards for IP interconnection

6.1 In this section we consider concerns that a lack of standardisation of IP interconnection may present a risk to telephone call quality and integrity. We have set out our initial views below and would welcome contributions from stakeholders.

Introduction

6.2 The transition from TDM to IP networks will be accompanied by a shift from TDM to IP interconnection. This means that the transport and signalling protocols will be different.⁴³ Whereas TDM interconnection is by means of TDM transport technologies and SS7 signalling, IP interconnection uses Ethernet transport technologies and SIP signalling.

6.3 Although both the transport and signalling protocols are defined in international standards, they contain multiple configuration options and do not describe the configuration required to interwork with the UK TDM signalling protocols during the transition period. Consequently, the international standards are not fully suitable for UK usage 'off the shelf'.

6.4 The UK interoperability standards authority NICC has therefore undertaken further standardisation work regarding standards for UK use which are, in most regards, profiles of the international standards.⁴⁴ Among other things, these profiles specify:

- Configuration options to ensure that the UK TDM signalling protocols are fully supported during the transition period when IP networks will coexist with TDM networks.
- Configuration options to support UK regulatory requirements such as Calling Line Identity (CLI) and emergency call location.
- End-to-end performance rules and objectives for call quality across the UK telephone system and the performance required from individual networks to achieve these rules and objectives.

6.5 Since the last narrowband market review, NICC has published several new IP interconnection standards largely completing its work on IP interconnection standards.⁴⁵

Adoption of NICC IP interconnection standards

6.6 IP network deployment has proceeded in parallel with development of both the international and NICC standards. Consequently, some operators deployed IP networks

⁴³ The messages used within and between networks to control call setup and tear-down.

⁴⁴ NICC has been the technical authority for interoperability standards since the introduction of competition in voice services. NICC was originally convened in 1991 as a committee reporting to our predecessor regulator OfTel. In 2006 NICC became an independent organisation owned by telecoms providers and equipment manufacturers.

⁴⁵ These publications include: ND1037 SIP NNI Interworking (IP to TDM interworking) and ND1653 on SIP overload control.

and IP interconnection before the NICC standards were finalised and may not be fully aligned with them.

- 6.7 NICC and other stakeholders have raised concerns that a lack of adherence to the NICC standards could pose a risk to the integrity of voice services, particularly during the transition to IP networks. Others have argued that, given the diversity of the telecoms sector (with many operators and equipment manufacturers) and the fact that BT's role is less central to telephony, it is unreasonable to expect that the NICC IP interconnection standards will be as widely adopted as the NICC TDM interconnection standards.

Potential risks associated with a lack of standardisation

- 6.8 There have been few problems to date because TDM interconnection is still widely used. However, as the transition to IP networks progresses and usage of IP interconnection increases, the risk of problems will increase. A lack of standardisation could potentially give rise to various problems including:

- **Call quality problems** – a range of configuration options affect call quality parameters such as clarity, delay and jitter (variation of delay). It is important that these configuration options are standardised to ensure that call quality is maintained, particularly for complex call routings across multiple networks where the cumulative effects of such configuration impairments are most pronounced.
- **Impeding development of higher call quality** – IP networks support higher call quality, which is comparable to the call quality that is already supported by 4G mobile networks, and better than the call quality that has traditionally been supported by fixed telephone networks. A lack of standardisation might result in this opportunity to improve call quality being missed.
- **TDM interworking problems** – during the transition period, TDM and IP networks will coexist. IP interconnection will therefore need to fully support the TDM signalling protocols to enable the transition to proceed smoothly and to avoid call failures.
- **Ancillary features** – interconnection signalling supports various ancillary features including CLI and emergency call location. Standardisation is needed to ensure these features operate reliably, in accordance with our regulatory requirements and data protection regulations.
- **Terminal equipment compatibility** – a range of configuration options can affect the operation of terminal equipment such as telecare and security alarms which use voice-band tones to communicate over the telephone network.

- 6.9 A lack of standardisation would also increase the cost of IP interconnection, as telecoms providers would need to support multiple configurations and potentially deploy hardware (for example for transcoding between voice codec standards).

Initial views

- 6.10 The telephone system is a central element of the UK's critical national infrastructure, so it is essential that it continues to operate with the utmost reliability during and after the

transition to IP networks. Telecoms providers have regulatory obligations to secure this outcome, including their obligation to take technical and organisational measures appropriately to manage risks to the security of networks and services⁴⁶ and, in offering telephony services to the public, to take all necessary measures to secure uninterrupted access to the emergency services.⁴⁷

- 6.11 If there is a lack of consensus about the technical standards for voice interconnection, this increases the risks described above materialising, with the potential for widespread harm to customers, including, at worst, a risk to life where there is no access to emergency services.
- 6.12 Our initial view is that some telecoms providers have a strong incentive to adopt the NICC standards for IP interconnection given their existing regulatory obligations and demand from people and businesses for high quality services. These standards have been developed by the expert industry body and are designed to offer the greatest assurance that IP voice interconnection will work reliably, particularly during the transition when interworking with TDM networks will be required. They should also reduce costs by avoiding the need for bespoke interconnection arrangements.
- 6.13 However, we acknowledge that some telecoms providers may wish to consider other interconnection standards and may already be using such standards given that IP network deployment commenced before the NICC standards were finalised. We are therefore, concerned that some telecoms providers may lack the resources to ensure that alternative interconnection arrangements are fully compatible with other UK networks and regulatory requirements. Consequently, our initial view is that, if there is a lack of standardisation of IP interconnection, this could present a material risk of consumer harm.
- 6.14 In view of these risks, we are considering whether it may be appropriate for us to take steps to mitigate these risks. Such steps might range from industry engagement to achieve consensus about the technical standards to more formal measures such as enforcement action of existing regulatory obligations, recognition of the NICC IP interconnection standards as UK standards or requiring telecoms provider to use certain NICC IP interconnection standards. The case for intervention and the nature of any action we take will depend on the extent to which there is or likely to be divergence among CPs in the standards of the IP interconnection technology they deploy and the materiality of the risk that this presents.
- 6.15 Our provisional view is that these issues could be considered further in the context of the forthcoming market review, concluding in 2021. However, in view of Openreach's WLR3 withdrawal plans we recognise that some telecoms providers may be making investment decisions concerning IP interconnection in the near future. We would therefore welcome stakeholder comments about whether it would be useful to bring this work forward.

⁴⁶ Section 105A, Communications Act 2003

⁴⁷ GC A3.

Question 6.1: Do you agree with our initial view that a lack of standardisation of IP interconnection may give rise to a risk of consumer harm?

Question 6.2: To what extent is there divergence among telecoms providers in respect of the IP standards they are using? Do you consider a lack of standardisation of IP interconnection to be (or likely to be) an isolated issue or more widespread, which may require an industry-wide solution?

Question 6.3: What measures, if any, do you consider may be appropriate to address risks arising from a lack of standardisation of IP interconnection?

Question 6.4: Would it be useful to consider the case for intervention in relation to technical standards for interconnection ahead of our next market review?

7. Future regulation of call termination

- 7.1 This section expands on developments that may have implications for our regulation of call termination, before discussing possible future regulatory options. We seek stakeholders' input on how we should take recent developments into account when setting regulated prices and the most appropriate regulatory option in light of these developments.

Current approach to regulation

- 7.2 As discussed in Section 3, Ofcom has concluded in previous market reviews that all telecoms providers that terminate calls on UK fixed geographic numbers and UK mobile numbers have SMP with respect to the (wholesale) market for terminating calls to the numbers they control.
- 7.3 In these reviews we concluded that, if unregulated, these telecoms providers would have the incentive and ability to refuse to supply call termination or fail to do so on fair and reasonable terms, and/or set excessively high termination rates. This could have a knock-on effect on retail markets, potentially distorting competition and leading to consumer harm.
- 7.4 To prevent this, for many years we have imposed charge controls based on a long-run incremental cost (LRIC) standard,⁴⁸ in addition to other remedies.⁴⁹ The FTR is currently capped at 0.0307 ppm and the mobile termination rate (MTR) at 0.479 ppm. This means that originating telecoms providers pay no more than the regulated FTR when they connect at the POI where the terminating telecoms provider has chosen to host its numbers. In contrast, the regulated MTR applies when an originating provider access MCT services at any handover point in the UK.

Article 75 of the EECC and the setting of EU-wide maximum FTRs and MTRs

- 7.5 Article 75 of the proposed European Electronic Communications Code (EECC) would, if implemented, set Europe-wide caps to fixed and mobile termination rate charges.⁵⁰ Although whether this will apply in the UK remains Brexit-dependent, we are working on the basis that, at the very least, it would be a relevant factor for setting UK termination rates in the future.

⁴⁸ LRIC are those costs which are caused by the provision of a defined increment or service – i.e. those costs that would not be incurred if that service was no longer provided, while all other services and products are still provided.

⁴⁹ We impose two obligations on all providers with SMP in both the WCT and MCT markets: a network access obligation and a charge control. There are four additional regulatory obligations on BT in the WCT market: to not unduly discriminate, publish a Reference Offer, undertake accounting separation and cost accounting. See Ofcom, 2017. *Narrowband Market Review: Statement*, Table 1.5.

⁵⁰ The proposed text is available at https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=comnat:COM_2016_0590_FIN.

- 7.6 Currently both fixed and mobile termination rates are subject to the 2009 Recommendation which specifies the approach to modelling and use of a LRIC cost standard, and fixed and mobile termination were included in the 2014 list of markets susceptible to the need for ex-ante regulation.
- 7.7 The EC is currently consulting on a revision to the Recommendation on relevant markets⁵¹ and plans to consult in Q3 2019 on a delegated act which will implement Article 75 (and Annex 3) of the EECC and see the EC itself set EU-wide maximum FTRs and MTRs ('Eurorates') from 31 December 2020. The EC consultation will cover the services to be included in the regulation and the need for a transition period, or glidepath.
- 7.8 The EC is currently modelling the costs of fixed and mobile termination and is consulting with operators and National Regulatory Authorities (NRAs). The modelling is not yet completed, although it appears likely the estimates of the LRIC of mobile call termination will be substantially below the UK's current regulated MTR (0.489ppm) and that it could be much closer to the UK's current FTRs (currently 0.0307ppm). The EC's modelling will only be completed in summer 2019, and it is possible that the eventual rate could be different from the initial estimates.

Market developments relevant for future regulation

- 7.9 Even if the Eurorates do apply, we consider that there is merit in discussing the future of termination regulation in a broader context of relevant market developments, in order to inform our approach to engaging with the forthcoming Implementing Act. In this way the situation is similar to the CFI we published in 2011 at the time that LRIC was introduced.⁵²

Convergence between mobile and fixed

- 7.10 Fixed and mobile voice services have become more similar in terms of how people engage with the services, pricing, network technologies and costs of providing services.
- 7.11 Most people now own a mobile and use this as their main method for making and receiving calls in the home.⁵³ Mobile use in the home sometimes uses the fixed connection, with broadband and WiFi providing the connection between the mobile handset and the mobile provider's core network.⁵⁴ The lines between both the use of fixed and mobile voice and how services are delivered are already blurred.
- 7.12 Traditionally, calls to mobile numbers were much more expensive than calls to geographic fixed line numbers. However, pricing of calls from fixed and mobile has also become more

⁵¹ See <https://ec.europa.eu/digital-single-market/en/news/consultation-revision-recommendation-relevant-markets>.

⁵² See http://stakeholders.ofcom.org.uk/binaries/consultations/mobilecallterm/summary/mobile_call_term.pdf.

⁵³ Ofcom survey data from 2017 suggests that 67% of those with a personal mobile and a landline see their mobile as the main method for making and receiving calls in the home (Ofcom, 2017. Phone Use in the Home Survey. https://www.ofcom.org.uk/data/assets/pdf_file/0016/114217/phone-use-home-survey.pdf).

⁵⁴ All the UK's major mobile network operators provide Wi-Fi calling, whereby mobile calls are relayed over a broadband line with a Wi-Fi connection, making no use of the mobile radio network. Wi-Fi calling offers some advantages to users and telecoms providers; it can be convenient and offer improved call quality in areas where cellular coverage is patchy. Calls are typically deducted from a mobile customer's monthly allowance or charged at the standard rate, as with any other call.

similar, with call allowances from most fixed and mobile providers now including calls to both fixed and mobile, as illustrated in Table 7.1 below.

Table 7.1: All calls to both fixed and mobile in call allowances?

Are calls to UK standard mobile and fixed line numbers both included in typical call allowances?			
Mobile providers	Pay monthly tariffs	Fixed providers	Anytime calls
EE	Yes. ⁵⁵	BT	Limited. ⁵⁶
O2	Yes. ⁵⁷	Plusnet	Limited. ⁵⁸
Three	Yes. ⁵⁹	Sky	Yes. ⁶⁰
Vodafone	Yes. ⁶¹	TalkTalk	Yes. ⁶²
		Virgin Media	Yes. ⁶³
		Vodafone	Yes. ⁶⁴

Source: Ofcom analysis, see footnotes for details.

- 7.13 At a network level, we are also likely to see increasing convergence between mobile and fixed telephony. Traditionally, fixed and mobile voice services have operated over two distinct networks; the TDM-based network for fixed services and a 2G/3G network for mobile services. Technology is evolving towards the use of a single IP core carrying both fixed and mobile services.
- 7.14 The costs of delivering voice services over mobile and fixed are also converging, principally as costs for mobile voice fall. In each of the last two reviews of MCT, our cost modelling established voice services on 4G networks have lower incremental costs than 3G networks,

⁵⁵ EE, Pay Monthly Allowances, <https://shop.ee.co.uk/sim-only/pay-monthly-phones#>.

⁵⁶ Certain packages include capped calls to BT Mobile only. See Unlimited Anytime Calls and Home Phone Saver 2020. BT, *BT Consumer Price Guide*, page 6. https://www.bt.com/assets/pdf/BT_PhoneTariff_Residential.pdf [accessed 20 March 2019].

⁵⁷ O2, Pay Monthly Allowances, <https://www.o2.co.uk/shop/sim-cards/sim-only-deals#deviceType=phone&contractLength=P12M>.

⁵⁸ Certain packages include capped calls to BT Mobile only. See Unlimited and Evening & Weekend packages. Plusnet, <https://www.plus.net/home-broadband/call-plans/> [accessed 20 March 2019].

⁵⁹ Three, http://www.three.co.uk/Store/SIM/Plans_for_phones.

⁶⁰ See the Sky Talk Anytime Extra and International Extra packages. Sky, *Sky Talk Tariff Guide*. See https://www.sky.com/shop/_PDF/SkyTalk_TG_01_May_2019.pdf [accessed 20 March 2019].

⁶¹ Vodafone, Pay Monthly Allowances, <https://www.vodafone.co.uk/mobile/best-sim-only-deals#overview>

⁶² See TalkTalk Boost packages, https://community.talktalk.co.uk/t5/Articles/About-our-Boosts/thread/2204813?advanced=false&collapse_discussion=true&filter=includeTkbs,location&include_tkbs=true&location=tkb-board:articles&q=boosts&search_type=thread [accessed 20 March 2019].

⁶³ See the Talk More Anytime, Talk Unlimited, and Talk Anywhere packages. Virgin Media's basic Talk Weekends package offers inclusive calls to Virgin Mobile numbers only. Virgin Media, *Everyday Call Charges*. See https://www.virginmedia.com/content/dam/virginmedia/dotcom/images/shop/downloads/010419_Everyday_Call_Charges_V2.pdf [accessed 20 March 2019].

⁶⁴ See the Anytime Landline and Mobile Calls package. Vodafone, *Your Price Plan for Vodafone Home Broadband and Phone*, February 2019, p. 4. See <https://www.vodafone.co.uk/cs/groups/public/documents/document/vfcon097921.pdf>

which in turn have lower costs than 2G networks. As traffic migrates to the new technologies, incremental costs are falling. It is also plausible that as mobile providers use more spectrum and a higher proportion of network capacity is used for data services, the incremental costs of mobile voice will fall further.

- 7.15 Important differences do remain between mobile and fixed networks however, for instance in call quality. In recent years, the UK's major MNOs have introduced improvements to the quality of mobile calls, enabling customers to make clearer 'HD Voice' calls between compatible devices. Customers of fixed networks have not seen equivalent improvements in quality over the same period. However, as networks transition to IP, HD Voice calling may become available over fixed telephony for the first time.⁶⁵
- 7.16 If fixed and mobile voice services continue the trend towards convergence, the case for greater harmonisation of fixed and mobile termination rates in future reviews will likely be strengthened. It may also be that service innovations such as HD Voice, and other future costs of managing calls such as for a common numbering database as discussed in a separate Ofcom consultation,⁶⁶ may lead to the cost of call termination being higher, and any harmonised call termination rate being higher than the current FTR.

Voice pricing is now less important in competition for customers

- 7.17 The prices of mobile contracts are now primarily driven by handsets and inclusive data allowances, while prices of call allowances are less important, and typically included within pay monthly tariffs.⁶⁷ Voice revenues now represent a small proportion of fixed and mobile revenues: with voice revenues now around £3bn against operator retail revenue of £30bn in 2017.⁶⁸
- 7.18 As customers make purchase decisions based on other factors such as fixed monthly prices, handsets, data allowances, broadband speed and quality, pricing of calls could become less important in competition for customers. In turn, as call termination charges represent only a small proportion of the cost of calls, it may be that call termination rates become less important to competition.

Risks of different or high termination rates

Arbitrage

- 7.19 As use of services converge, there is the risk that providers will make choices between the use of fixed or mobile numbers based upon the termination rate that can be charged rather than the characteristics of the service. For any given service, if that difference in termination rates does not reflect the difference in service costs, that could lead to inefficient choice of numbers and unreasonable costs to callers. This may be mitigated if

⁶⁵ Incumbent operators in some countries have advertised HD voice calling as a pull factor in migrating voluntarily to IP. Plum Consulting, *Preparing the UK for an All-IP future: experiences from other countries*, 2018, page 22.

⁶⁶ Ofcom, 'Promoting trust in phone numbers', April 2019.

⁶⁷ Ofcom, 'Pricing trends for communications services in the UK', May 2018, p. 14.

⁶⁸ <https://www.ofcom.org.uk/research-and-data/multi-sector-research/cmr/cmr-2018/interactive>.

termination rates for fixed and mobile numbers were to converge as services (and the use of numbers) converge.

Artificial inflation of traffic

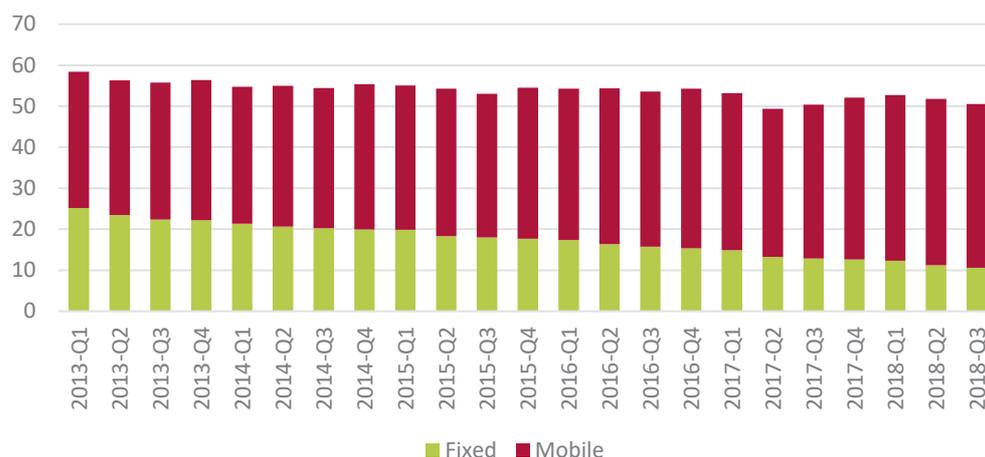
7.20 If termination rates are above the costs of the service provided on that number, there is an incentive for the terminating provider to encourage more calls to that number. In some cases, this could encourage bad actors to generate artificially high traffic, such as by encouraging calls to certain numbers from large or unlimited call allowances. This behaviour imposes costs on all users by increasing the costs of providing a telephone service.

7.21 Although providers can and do take measures to identify and tackle the artificial inflation of traffic, this will not completely remove any abuse and in any case imposes a cost of monitoring and enforcement. The incentive for artificial inflation of traffic can be reduced or removed by having cost-based termination rates.

Change in use of voice services

7.22 Total fixed and mobile voice usage is falling, as shown in Figure 7.2 below, which is symptomatic of a fundamental change in people’s behaviour; there has been a steady shift from fixed to mobile use and web-based forms of communication are now the primary way in which many people use their mobile phones. Increasingly people are using OTT voice and messaging applications as alternatives to telephony. This is not to say that voice is now unimportant: for instance, businesses continue to rely on landlines, with the vast majority using and rating their fixed voice service as important.⁶⁹

Figure 7.2: Fixed and mobile originated voice minutes (billions of minutes)



⁶⁹ 96% of businesses use landlines and 64% consider their voice service absolutely vital (overall 97% consider landlines absolutely vital, very important or somewhat important). Jigsaw Research, 2017. The SME experience of communications services: research report. https://www.ofcom.org.uk/data/assets/pdf_file/0030/96348/Ofcom-SME-consumer-experience-research-2016-Report.pdf

Source: Ofcom, *Telecoms Data Tables*.

- 7.23 More recently, we have seen an increase in OTT VoIP services offering the capability to terminate calls on landlines or mobiles, particularly as smart speakers have become more advanced.⁷⁰ The first mass market dedicated smart speaker, the Amazon Echo, launched in the UK in 2016. Since then, the devices have grown steadily in popularity; 13% of UK households now own a smart speaker.⁷¹
- 7.24 As noted in Section 2, traditional fixed and mobile telephony services are interoperable and offer ‘end-to-end connectivity’, whereby any telephone users can call any other number on any network. In contrast, Google Home smart devices operate in a semi-closed network, taking advantage of low termination rates to allow users to make free calls to telephony services from their device. However, users cannot receive any inbound calls to their Google Home device. We refer to this as one-way call services.
- 7.25 If growth in the adoption of smart devices and substitution to the use of their OTT services continues, it is likely that there will be a decline in usage of fixed telephony (with end-to-end connectivity).⁷² In addition, these OTT VoIP call services (as currently offered) do not provide certain features of traditional telephony that people have come to expect, and that Ofcom’s regulation has sought to protect. For instance, in providing one-way call services only, these devices do not contribute to the positive network effect of end-to-end connectivity, whereby any telephony user can contact and be contacted by any other user.
- 7.26 If evidence does emerge that the growth of one-way call services could undermine the end-to-end connectivity currently provided by traditional telephony, we may want to consider whether it would be appropriate to intervene. We note that:
- a) Ofcom has previously intervened to promote network effects by allowing a ‘network externality surcharge’ on MTRs in the early 2000s. This was designed to promote adoption of the then relatively new mobile services by cross-subsidising subscriptions. However, it is unclear if such an indirect intervention would be appropriate or effective. For the reasons discussed below in the context of the appropriate cost standard, it is not clear that a modest increase in termination revenues would influence the incentives of one-way providers, or filter through to retail customers and, if so, could impact consumer behaviour.
 - b) Article 61 of the EECC provides a legal basis for NRAs to impose obligations on those that control access to end-users to make their services interoperable, which may provide a mechanism to require the one-way call platforms to interoperate with telephony. Some parts of this are specific to ‘number independent’ services, but also

⁷⁰ Smart speakers operate by connecting to the internet and are controlled by the user’s voice. The device uses an AI voice assistant (e.g. Alexa, Siri) to respond to the user.

⁷¹ Ofcom, 2018. *Communications Market Report 2018*, Figure 1.4.

⁷² An absolute decline of mobile telephony use due to these one-way call services seems far less feasible compared to fixed, given the latter’s long-term decline in use. It is also particularly unlikely given the ongoing use of mobile number ranges, as well as many OTT services’ reliance on mobile numbers for their services.

require that there needs to be a significant problem in several countries before the Commission will approve the use of this provision.

Regulatory Options

- 7.27 We have historically focused on the following factors to determine what remedies best address providers' ability to set excessive terminations rates, due to their SMP in termination:⁷³
- i) **Economic efficiency** - Whether the structure of termination charges could lead to distortions in the consumer choices, leading to people consuming more of some services than is efficient (and less for some than is efficient).
 - ii) **Competition concerns** - Whether termination charges could create competitive distortions for smaller networks, leading them to be disadvantaged compared to larger or more established networks.
 - iii) **Distributional impacts** - Whether termination charges could result in certain people being affected more than others. For example, if there could be a disproportionately large impact on fixed-only, mobile-only and fixed-mobile customers.
 - iv) **Commercial and regulatory consequences** - If termination regulation could have implications for the recovery of common costs, excessive regulatory burden or risk of failure.
- 7.28 We have initially identified three broad level options: continuing to set a cap on prices based on LRIC; moving to a LRIC+ cost standard; and the imposition of regulation that requires reciprocal rates.
- 7.29 We also considered the options of deregulation and mandated Bill and Keep. At this stage, our preliminary view is that these options are unlikely to be appropriate. Deregulation of the fixed termination rate would fail to address the concerns arising from telecoms providers' SMP in terminating calls. Under mandated Bill and Keep ('B&K'), termination rates are effectively set at zero, with payments among telecoms providers for termination services effectively waived. Each provider bills its own retail customers and keeps all the revenue, not making any interconnection payment. This option would appear to have a number of shortcomings, including removing incentives to invest, distorting competition by benefiting net originators at the expense of net terminators, or leading to an increase in nuisance calls.

⁷³ Ofcom, 2018. Mobile Call Termination Market Review 2018-2021 – Final Statement, paragraphs 4.77-4.79 of the 2018 MCT Market Review, we note the continued application of the four criteria. In the 2017 Narrowband Market Review, in footnote 655 we note that the approach to remedies (as outlined in 2013 Narrowband Market Review, paragraphs 8.27-8.35) is consistent with the four criteria used in MCT market reviews.

LRIC

- 7.30 Since the 2011 MCT market review, we have used a LRIC cost standard for our charge control on MTRs. The LRIC based approach was subsequently also adopted for our charge control on FTRs in 2013.
- 7.31 We selected the LRIC cost standard largely because it was better at addressing our competition concerns regarding the potential for on-net/off-net price discrimination by network operators. There were also concerns about the potential impact on competition between fixed and mobile networks in the future (if the two networks began to converge), which were more effectively addressed by the LRIC cost standard.
- 7.32 As discussed above, with the focus of retail competition having shifted to data services, the potential for benefits to competition from keeping LRIC-based termination rates, although present, is more limited than in the past.
- 7.33 However, maintaining the existing LRIC cost standard would provide the best stability and certainty (given that it is the status quo). Such an approach is also consistent with the EC recommendation,
- 7.34 If we were to maintain LRIC, future charge controls could be set using the model that has already been developed by the EC for the setting of the new Eurorates (under Article 75 of the EECC) or at least look to it as a relevant benchmark. Adoption of the new Eurorates model would mean a significantly reduced regulatory burden in establishing call termination rates.

LRIC+

- 7.35 Switching back to a LRIC+ cost standard could have some benefits, such as increasing the viability of traditional voice telephony in the face of new one-way call services that exploit existing low termination rates.
- 7.36 However, it is questionable whether the relatively small increment from LRIC to LRIC+ would provide fixed telephony operators with a sufficient margin to resist what is a structural (non-price) decline. Furthermore, it is uncertain whether a termination rate uplift would actually do anything to entice one-way call services providers to offer end-to-end connectivity, and if a lack of interoperability with these services is deemed to be an issue then there may be more direct ways to address it.
- 7.37 A shift back to LRIC+ would also run counter to our previous arguments about the competition benefits of termination rates set using LRIC, because LRIC+ raises the cost of customers making calls to other networks, in turn reducing the incentive (and/or ability) of providers to compete for retail customers. Even if the focus of competition is now on data rather than voice services, use of LRIC+ could potentially facilitate the re-emergence of competitive distortions.

Mandated reciprocity

- 7.38 Under this option we could require all fixed and mobile networks operators to offer rates that are fair and reasonable, which we would in this case interpret as including an obligation that rates be reciprocal. This could be further supported by a no undue discrimination obligation.
- 7.39 We envisage that mandated reciprocity could take one of two forms:
- 1) Mandated reciprocity with no benchmark – Operators could be free to negotiate and implement rates that are as high or low as they desire.
 - 2) Mandated reciprocity with a benchmark - We could set a specific benchmark, which would function as a safeguard cap, with operators being free to negotiate rates below that.
- 7.40 Although we do not propose to set out the regulatory mechanism by which this policy outcome could be achieved, we note the similarity to our decision in 2013 in relation to non-geographic call services,⁷⁴ where we imposed an Access Condition in relation to 080 numbers that required terminating providers to purchase origination services on fair and reasonable terms, including charges. We subsequently established rates that we considered to be fair and reasonable through a dispute.⁷⁵
- 7.41 This approach could reduce the regulatory burden of the termination regime (at least in terms of ex ante regulation). However, if there is no cap on charges, a likely result would be providers adopting a variety of different bilateral termination rates, which could depart from the efficient rate (if not rise to monopoly levels). Another likely outcome would be that a few providers would use the increased flexibility to charge high termination rates, which would lead other telecom providers to exclude their numbers from their customers' inclusive minutes, leading customers to face bill shock, and potentially leading to reduced confidence in telephony.
- 7.42 However, there could be some merit in a mandated reciprocity option with a benchmark. In the context of declining fixed volumes, there could be a regime where the benchmark for both fixed and mobile call termination is set at the same level, although the cap could be set at LRIC for mobile call termination. Fixed operators would therefore be able to charge rates under MCT LRIC, but above the costs for WCT, as long as the commercially negotiated rates are reciprocal.
- 7.43 An additional benefit of having reciprocal termination rates between mobile and fixed network, is that it should prevent operators from exploiting the arbitrage opportunities that currently exist due to the difference between current MTRs and FTRs.

⁷⁴ Ofcom, Simplifying non-geographic numbers, December 2013, https://www.ofcom.org.uk/data/assets/pdf_file/0017/72116/final-statement.pdf

⁷⁵ For further information regarding the dispute in relation to mobile call origination for 080 see https://www.ofcom.org.uk/about-ofcom/latest/bulletins/competition-bulletins/all-closed-cases/cw_01126.

Question 7.1: What are your views on the factors that we have highlighted as having a bearing on the setting of termination rates? What other developments should we consider?

Question 7.2: What are your views on the options we present for regulating the fixed and mobile call termination markets? Which appears to be the most appropriate regulatory option?

A1. Responding to this consultation

How to respond

- A1.1 Ofcom would like to receive views and comments on the issues raised in this document, **by 5pm on 6 June 2019**.
- A1.2 You can download a response form from <https://www.ofcom.org.uk/consultations-and-statements/category-2/future-of-interconnection-and-call-termination>. You can return this by email or post to the address provided in the response form.
- A1.3 If your response is a large file, or has supporting charts, tables or other data, please email it to icandtermination@ofcom.org.uk, as an attachment in Microsoft Word format, together with the cover sheet (<https://www.ofcom.org.uk/consultations-and-statements/consultation-response-coversheet>). This email address is for this consultation only, and will not be valid after 10 June 2019
- A1.4 Responses may alternatively be posted to the address below, marked with the title of the consultation:
- Shaun Tey
Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA
- A1.5 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.
- A1.6 We will publish a transcript of any audio or video responses we receive (unless your response is confidential)
- A1.7 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.
- A1.8 You do not have to answer all the questions in the consultation if you do not have a view; a short response on just one point is fine. We also welcome joint responses.
- A1.9 It would be helpful if your response could include direct answers to the questions asked in the consultation document. The questions are listed at Annex 4. 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.

A1.10 If you want to discuss the issues and questions raised in this consultation, please contact Shaun Tey on 02079813510, or by email to icandtermination@ofcom.org.uk.

Confidentiality

A1.11 Calls for Inputs 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 our website, www.ofcom.org.uk, as soon as we receive them.

A1.12 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.

A1.13 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.

A1.14 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 at <https://www.ofcom.org.uk/about-ofcom/website/terms-of-use>.

Next steps

A1.15 Responses to this consultation will be used to inform future proposals on interconnection and termination markets, which we expect to publish in 2020.

A1.16 If you wish, you can register to receive mail updates alerting you to new Ofcom publications; for more details please see <https://www.ofcom.org.uk/about-ofcom/latest/email-updates>

Ofcom's consultation processes

- A1.17 Ofcom aims to make responding to a Call for Inputs as easy as possible. For more information, please see our consultation principles in Annex x.
- A1.18 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.
- A1.19 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

A2. Ofcom's consultation principles

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

Before the consultation

- A2.1 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

- A2.2 We will be clear about whom we are consulting, why, on what questions and for how long.
- A2.3 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.
- A2.4 We will consult for up to ten weeks, depending on the potential impact of our proposals.
- A2.5 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.
- A2.6 If we are not able to follow any of these seven principles, we will explain why.

After the consultation

- A2.7 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.

A3. 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)

A4. Consultation questions

Question 4.1: Do you agree that if BT's migration to an IP network is unpredictable, it could result in increased charges for providers routing calls to its network? Are there any other issues that might arise as a result of its migration?

Question 4.2: Please state which of these measures you consider would be appropriate for securing efficient migration and why?

Question 4.3: Would the regulation of charges for media conversion, switching and conveyance for calls routed via IP networks be an effective means of preventing excessive charges and promoting an efficient migration to IP?

Question 4.4: Do you agree that it remains appropriate that telecoms providers maintain their discretion to designate a single POI at which the FTR will apply?

Question 4.5: Do you agree with our assessment about how BT's market position in relation to interconnection might change during migration to IP?

Question 4.6: Do you agree that there is unlikely to be a need to impose regulation on BT's interconnection circuits once migration to IP is complete?

Question 4.7: Do you agree that we should continue to regulate BT's TDM interconnection circuits as the industry migrates from TDM to IP based networks?

Question 4.8: Do you agree that it would not be necessary to impose regulation on interconnection circuits at BT's IP network during migration?

Question 5.1: Do you agree that BT's role is less central to the provision of end-to-end connectivity and that telecoms providers now have a choice of transit providers with whom they can interconnect?

Question 5.2: How might the transition to IP networks change the pattern of interconnection and how might this affect how E2E connectivity is achieved?

Question 5.3: Do you agree that General Condition A1 is sufficient to ensure that telecoms providers can obtain interconnection and that additional access obligations may no longer be required to ensure end-to-end connectivity? If not, please explain why and what obligations you think are necessary.

Question 6.1: Do you agree with our initial view that a lack of standardisation of IP interconnection may give rise to a risk of consumer harm?

Question 6.2: To what extent is there divergence among telecom providers in respect of the IP standards they are using? Do you consider a lack of standardisation of IP interconnection to be (or likely to be) an isolated issue or more widespread, which may require an industry-wide solution?

Question 6.3: What measures, if any, do you consider may be appropriate to address risks arising from a lack of standardisation of IP interconnection?

Question 6.4: Would it be useful to consider the case for intervention in relation to technical standards for interconnection ahead of our next market review?

Question 7.1: What are your views on the factors that we have highlighted as having a bearing on the setting of termination rates? What other developments should we consider?

Question 7.2: What are your views on the options we present for regulating the fixed and mobile call termination markets? Which appears to be the most appropriate regulatory option?

A5. Glossary

Access network	The part of a telecoms provider’s network that connects customers’ premises to the telecoms provider’s Local Access Node, which in the case of BT is the local exchange.
ADSL (Asymmetric Digital Subscriber Line)	A technology that enables data transmission over copper telephone lines at download speeds of up to 24 Mbit/s.
B&K (Bill and Keep)	An approach to termination pricing where communications providers make no payments to each other for call termination (that is, termination rates are zero).
BT	British Telecommunications plc.
CBC (Capacity-based Charges)	An approach to setting the structure of termination charges based on the capacity required for termination.
Charge control	A control that sets the maximum price that a telecoms provider can charge for a particular product or service. Most charge controls are imposed for a defined period.
CLI (Calling Line Identity)	Data about the calling party, in particular the telephone number that has initiated the call.
Common costs	Costs that are shared across multiple services supplied by a firm.
Conveyance costs	The cost of providing ‘onward routing’ of calls between networks.
Conversion costs	The cost of converting media between TDM and IP-based networks.
Countervailing buyer power	The restraint a buyer is able to place on any attempt by the seller to set its prices above the competitive levels.
CPP (Calling Party Pays)	An arrangement where the calling party (and not the called party) pays a charge when a call is made.
CPI (Consumer Price Index)	The official measure of inflation of consumer prices in the UK.
DLE (Digital Local Exchange)	The local exchange switching component in BT’s telephone network. Customer lines are connected to remote concentrator units subtended to DLEs.
E2E Condition (End-to-end condition)	An access condition on BT under sections 73 and 74 of the Communications Act 2003 which requires BT to purchase wholesale call termination services as soon as reasonable practicable and on reasonable terms and conditions, including charges.
EC	European Commission.
EECC	European Electronic Communications Code.

End-to-end connectivity	The facility for users of retail telephone services to call all other telephone users on their provider’s network and those on all other providers’ networks.
End user	The final consumer of a product or service.
Ethernet	A packet-based technology originally developed for use in Local Area Networks (LANs) but now also widely used in telecoms providers’ networks for the transmission of data services.
F&R	Fair and reasonable.
FTR (Fixed Termination Rate)	The wholesale charge levied by fixed telecoms providers for WCT.
FTTC (Fibre-to-the-Cabinet)	An access network structure in which optical fibre extends from the exchange to a cabinet housing broadband equipment such as DSLAM, located close to a PCP. The remaining part of the access network from the cabinet to the customer is usually copper wire but could use another technology, such as wireless.
GC (General Condition)	One of the General Conditions of Entitlement imposed under the Act, which apply to all telecoms providers or all telecoms providers of a particular type.
Glidepath	A series of steps from a point of origin to a target. For example, a series of steps from a starting price in a charge control to the price at the end of the control.
Hull Area	The area defined as the ‘Licensed Area’ in the licence granted on 30 November 1987 by the Secretary of State under Section 7 of the Telecommunications Act 1984 to Kingston upon Hull City Council and Kingston Communications (Hull) plc (KCOM).
Interconnection	The linking (whether directly or indirectly by physical or logical means) of one network and another, enabling end users of different networks to communicate with one another and to access services provided on a different network.
Interconnect circuits	Communications circuits used to facilitate interconnection.
IP (Internet Protocol)	Packet data protocol used for routing and carriage of messages across the internet and other modern communications networks.
IPEX	BT’s IP Exchange IP interconnection service.
ISP (Internet Service Provider)	A company that provides customers with internet access.
Jitter	A measure of variation of delay in transmission over a transmission path.

LRIC (Long-run Incremental Costs)	Only those costs which are caused by the firm’s provision of a defined increment or service including fixed costs specific to that increment or service – i.e. those costs that would not be incurred if the firm was structured in such a way as not to provide that service, while still producing all other services and products that are currently produced.
LRIC+	The long-run (average) incremental costs plus a mark-up for the recovery of shared and common costs (often in the form of an equi-proportionate mark-up). LRIC+ should be taken to mean the same as LRAIC+ (a term used by some other NRAs).
Mandated reciprocity	Where mobile termination rates and fixed termination rates are set at the same level.
MCT (Mobile Call Termination)	A wholesale service provided by a mobile telecoms provider to connect a call to a recipient on its network.
MNO	Mobile network operator.
MTR (Mobile Termination Rate)	The wholesale charge levied by mobile telecoms providers for MCT.
NICC	A technical forum for the UK communications sector that develops interoperability standards for public communications networks and services in the UK. It is an independent organisation owned and run by its members, which include Ofcom.
NMR	Narrowband Market Review.
NRA (National Regulatory Authority)	The communications regulatory body for each EU Member State assigned tasks under the Framework Directive. Ofcom is the NRA for the United Kingdom.
Off-net call	A call that terminates on a network different to the one it originated on; that is, calls between customers of different networks.
On-net call	A call originated and received by customers of the same network.
OTT (Over the top)	A service that allows end-users to make and receive voice calls using an internet connection where the service is provided independently of the provision of the internet connection.
POC (Point of Connection)	The demarcation point between two telecoms providers’ networks.
POI	Point of interconnection
Ppm	Pence per minute
PSTN (Public Switched Telephony Network)	The telephony network used to provide telephone calls using (or emulating) circuit-switching and using telephone numbers to identify

subscribers or called locations, allowing all customers connected to the network to call all other customers.

RFS (Regulatory Financial Statements)	The financial statements that BT is required by Ofcom to prepare, have audited and publish.
Reference offer	The terms and conditions on which the Dominant Provider will enter into an Access Agreement.
SIA (Standard Interconnect Agreement)	BT's standard terms and conditions for the provision of interconnection and related services.
SIP (Session Initiation Protocol)	A signalling protocol that is commonly used for calls over IP networks.
SMP (Significant Market Power)	The European Directive requires NRAs to determine whether operators have significant market power and impose appropriate regulatory obligations in such cases. An undertaking will have significant market power if, either individually or jointly with others, it enjoys a position equivalent to dominance, that is to say a position of economic strength affording it the power to behave to an appreciable extent independently of competitors, customers and ultimately consumers.
SS7 (Signalling System No. 7)	A set of telephony signalling protocols used for interconnection between TDM telephone networks.
TDM (Time Division Multiplexing)	A multiplexing technique used to transmit multiple data streams over a single bearer. This technique is used in older telephone networks (those that predate the transition to IP networks) and which are commonly referred to as TDM networks.
VoIP (Voice over IP)	The transmission of voice signals over an IP network such as the internet or a modern fixed or mobile telephone network. Voice signals are digitised and transmitted across the network in discrete data packets.
WCO	Wholesale fixed call origination services.
WCT	Wholesale fixed geographic call termination services.