7. Internet access services

Overview

7.1 With the continued growth in consumption of both fixed and mobile data services, the overall role of internet access services in meeting consumer communications needs continues to grow in importance. In this section we touch on some of the areas relevant to this continued evolution of internet services and how regulators and policy makers need to remain vigilant in ensuring that these services continue to operate in an equitable and open way.

7.2 It is a key policy objective that ISPs (Internet Service Providers) continue to provide services that allow access to all sources of online content and that any traffic prioritisation of particular services is not implemented in a way that compromises the "open" internet.

7.3 We have sought to confirm that work already undertaken in order to demonstrate compliance to other aspects of the EU Telecoms Single Market (TSM) Regulations is clear and comprehensible.

7.4 The TSM came in to force during 2016. We have undertaken work in order to demonstrate compliance with key aspects of it, particularly those dealing with Quality of Service, reporting of Broadband services, coverage maps, compliance with net-neutrality rules and ensuring information to customers is clear and comprehensible. We have also undertaken work to improve the quality and outcomes for consumers in regard to proposing changes to the broadband Codes of Practice on broadband speeds[69], in line with the regulations and action from the ASA.

7.5 To enhance the Codes, we are proposing to:

a) Improve information about line specific speed at the point of sale and in contracts, by reflecting the slower speeds people can experience at 'peak' times; and by ensuring providers always give a minimum guaranteed speed before sale.

b) Strengthen the right to exit if speeds fall below a guaranteed minimum level. Providers would have a limited time to improve speeds before they must let customers walk away penalty-free. For the first time, this right to exit would also apply to contracts that include phone and pay-TV services bought with broadband.

c) Increase the number of customers who benefit from the Codes, by expanding their scope to apply to all broadband technologies.

7.6 Our expectations are to publish a final decision early next year, alongside a consumer guide to help raise awareness of the additional benefits of the improved Code.

[69] https://www.ofcom.org.uk/consultations-and-statements/category-1/broadband-speeds-codes-practice

7.7 Driven by the continued growth in consumption and availability of long and short form video content, the content distribution model continues to evolve, with a number of large and small distribution platforms serving the market. Larger content providers have developed and deployed their own Content Delivery Network (CDN)[70] infrastructure, and we are also seeing market entry and growth in use of services from more generic cloud based infrastructure providers.

EU Regulations on Net Neutrality

7.8 In April of 2016, the EU Telecoms Single Market Regulation on net neutrality rules came into force in the UK. The scope and implications of this regime were examined in some detail in the 2016 Connected Nations Report[71]. In June 2017 we published our first report to the European Commission on our approach to monitoring and ensuring compliance with EU Regulation 2015/2120 on open internet access from May 2016 to April 2017.[72]

7.9 Our key statement from this report found "our work suggests that there are no major concerns regarding the openness of the internet in the UK," we go on to state "however we have identified some areas that require improvement in ISP compliance with the Regulation. We will continue our work on the provision of speeds and other information by ISPs during 2017-18, as well as the monitoring of ISPs' practice."

7.10 This position is as a result of the fact that the UK was already broadly in line with EU regulation, prior to its introduction, as we have worked with industry, via the Broadband codes of practice[73] and Broadband speed quality reporting programmes, to ensure that many of the requirements laid down in Articles 3, 4, and 5 of the Regulation (EU) 2015/2120[74] were consistent with existing self-regulatory measures.

Implementation actions

7.11 We currently have an on-going programme of work to address the requirements of the EU TSM Regulation. This programme includes reviewing the existing voluntary Broadband Speeds Code[75] that is already in place and supported by major fixed providers, and establishing a process to discharge our obligations with regard to the measurement and reporting on the quality of Internet Access Services (IAS).

7.12 We continue to check the compliance of the UK's main ISPs' residential consumer contractual provisions with relation to the impact of traffic management on the quality of the IAS, and on consumer privacy and the protection of personal data.

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[70] CDNs are networks of servers based in many geographic locations, typically closer to the end user, designed to improve the speed and quality of content delivery by routing requests to the nearest server.
[71] https://www.ofcom.org.uk/__data/assets/pdf_file/0035/95876/CN-Report-2016.pdf
[72] https://www.ofcom.org.uk/research-and-data/internet-and-on-demand-research/net-neutrality
[73] https://www.ofcom.org.uk/phones-telecoms-and-internet/information-for-industry/codes-of-practice
[74] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2015.310.01.0001.01.ENG&toc=OJ:L:2015:310:TOC
[75] https://www.ofcom.org.uk/consultations-and-statements/category-1/broadband-speeds-codes-practice

7.13 We made some proposals to revise the Broadband Speeds Codes of Practice for businesses and residential consumers. We are proposing to strengthen the Codes and ensure that speed information given at point of sale and after sale is in line with the specification of the EU TSM Regulation and consistent across providers. This is to ensure more realistic estimated speed measures are given to consumers, as well as an easier route for redress. We are consulting on the revised Codes and the conclusions of the consultation will be published in early 2018.

7.14 Our proposals focus on:

- Speed measurements from the customer premise equipment (CPE) to the Internet gateway of the provider's network: currently the measurement is only taken on the broadband access element of the service.
- Measuring and taking into account the speed of the service during busy hours allowing for the effects of contention on the service.

7.15 We are currently assessing the options with regard to mobile operators demonstrating compliance with the speed information provision requirements of the EU TSM Regulation, and the potential need for mobile providers to publish meaningful speed guidance to consumers based on location. One option could be to define a common standard for operators to provide a fair reflection on data speeds, taking into consideration the variabilities in mobile network operation.

7.16 In this context, it is worth noting that the Advertising Standards Authority (ASA) has published research into consumers' understanding of broadband speed claims made in adverts.[76] The research found that speed is an important factor for a significant proportion of consumers who are making decisions between providers. However, levels of knowledge and understanding of broadband speeds vary, and are low overall with many not knowing what speed they need to carry out daily online tasks.

7.17 Most consumers understand that the higher the number in the advertisement, the higher the speed of the service, but many are unclear on what this means for them and what speed they would likely achieve. Despite that uncertainty, most consumers believe they are likely to receive a speed at or close to the headline speed claim when, for many, that is not likely to be the case because the advertised speeds are based on the maximum speeds available to the top 10% of customers.

7.18 As a result, the ASA's sister body, the Committees of Advertising Practice (CAP), has been reviewing its guidance to advertisers on broadband speed claims and consulted[77] on potential alternatives in Summer 2017. It recently published a statement on conclusions and future policy.[78] In parallel, it also published new guidance that numerical speed claims in broadband advertisements should reflect the download speed available to at least 50%

[76] https://www.asa.org.uk/News-resources/Media-Centre/2016/ASA-calls-for-a-change-in-the-advertising-of-broadband-speed-claims.aspx#.WDxjtX2uqgE
[77] https://www.asa.org.uk/resource/consultation-on-speed-claims-in-broadband-advertising.html
[78] https://www.asa.org.uk/news/asa-concludes-review-of-fibre-broadband.html

of customers at peak time and described as an average speed.[79] Ofcom will work with the ASA and CAP to ensure continuing consistency of approach.

Traffic management practices

7.19 Traffic management (TM) is a necessary aspect of ISPs' network management practices. Better controlling the flow of traffic across an ISP's network by using TM can benefit consumers by improving the performance of their broadband connections at peak times. However, there are concerns that through their use of it, ISPs might manage traffic on their networks in ways which can cause consumer harm or limit online innovation.

7.20 In light of this, the TSM Regulation requires ISPs to be fully transparent in what they do in regard to TM. There is an industry-wide code of practice explaining how they should comply with this (the Broadband Stakeholders Group Open Internet Code of Practice[80]) which requires that each ISP publish a table summarising its TM policy for each package on offer. These tables are known as Key Facts Indicator (KFI) and can be found on all ISPs' websites.

7.21 We review these key facts indicators and customer terms and conditions, reporting on them each year as part of this report. Our conclusion is that, broadly, transparency about TM practices has improved, and in general TM policies are either non-existent or less restrictive than they were a few years ago.

7.22 For many fixed networks, TM policies are rarely if ever invoked, although providers do not yet make fully transparent what they would do if networks have serious faults or are congested to ensure adequate performance for time critical applications. This is an area we are examining and will aim to report back on in the 2018 Connected Nations report.

7.23 Mobile networks generally claim not to use TM unless congestion becomes an issue, but this can happen both as a result of normal 'time of day' variations in overall loading and as a result of more random increases in users and consequent traffic in particular geographic areas and the cell sites that serve them. They also use data caps and speed limits as another means of managing demand, which may have a much more fundamental impact on the customer experience.

7.24 In the light of the new, formal powers and responsibilities for this area under the TSM, we have decided to open our own-initiative enforcement programme into fixed and mobile traffic management measures.[81] The programme will focus on gathering information and assessing whether any ISP practices raise compliance issues in order to determine whether any further action, including possible enforcement actions, might be required.

7.25 We continue to explore how best to assess and measure the mobile broadband consumer experience. In H1 2017 we conducted a number of drive tests to confirm operator

[79] https://www.asa.org.uk/news/major-change-to-broadband-speed-claims-in-ads.html
[80] http://www.broadbanduk.org/wp-content/uploads/2016/06/BSG-Open-Internet-Code-2016.pdf
[81] https://www.ofcom.org.uk/about-ofcom/latest/bulletins/competition-bulletins/open-cases/cw_01210

information on signal levels and are currently articulating these results with mobile operators, with a view to improve how they report coverage. Currently this has identified that users can expect to receive more than 2Mbit/s for 90% or more of the time, further validating our 2016 "Smartphones Cities" report.[82] Whilst this seems likely to deliver a good quality of experience for users, it does emphasise that congestion and, hence, TM can have a significant impact during peak periods or other congestion episodes.

7.26 We continue to monitor and refine our mobile quality metric reporting and currently utilise crowd sourced data collected through our mobile research application[83] for Android phones.

7.27 As mobile networks, and the customers who use them, complete the transition to a fully 4G environment, voice services could be delivered using 4G voice or VoLTE technology. Since voice will now be transported as any other data service session, ensuring prioritisation during busy periods or localised congestion will become more important, particularly for calls to the emergency services. We will continue to monitor TM application in this context to ensure voice service quality is maintained.

Internet interconnection trends

7.28 Internet interconnection can be defined as a business and network relationship where there is an exchange of customer traffic between administratively separate Internet networks know as Autonomous Systems. There are many different ways in which ISPs can exchange their customers' traffic with each other. These include transit, public and private peering and through the deployment and interconnect of Content Delivery Networks (CDNs).

Peering

7.29 With peering, both parties tend to meet at a carrier neutral location known as an internet exchange point (IXP) which can be located in the UK or globally. At this exchange point they are able to connect either directly to another network or via the exchange's equipment. The latter is often known as public peering, the former as private peering, this term also being used to describe interconnection at one or other of the parties' own premises.

7.30 In the case of public peering each ISP pays its own costs for connecting into the exchange's switch. In the case of private peering there are many commercial alternatives available to ISPs, which in many cases may depend on the ratio of traffic exchanged between the two parties.

7.31 With larger content providers, the ratio between the traffic sent by each of the peers is now typically relatively high and very different from the 1:1 ideal of 'balanced' peering, as

[82] https://www.ofcom.org.uk/research-and-data/telecoms-research/mobile-smartphones/smartphone-cities
[83] https://www.ofcom.org.uk/phones-telecoms-and-internet/coverage/ofcom-mobile-research-app

a content provider such as Netflix sends a significantly larger volume to the ISP's customers than vice versa.

7.32 However, private peering offers ISPs direct connection to the content and thus removes possible issues that can occur in public internet peering connections, which can become congested. Peering also offers a cost reduction to ISPs by moving traffic away from paid transit connectivity.

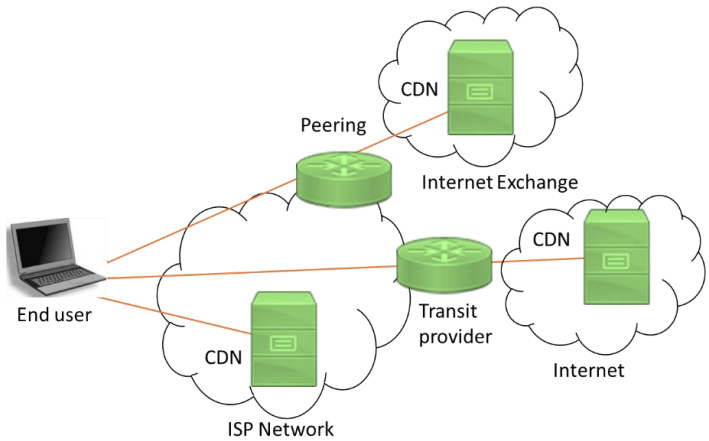
Transit

7.33 Transit is when a party pays for access to either all possible destinations in the Internet, or only within a geographic region i.e., destinations with the UK only. There are a number of Internet backbone providers who deliver transit services, due to the size of the internet, and backbone providers will agree peering arrangements between themselves thus creating the global internet. ISPs have little control of a customer's traffic when it leaves their network and rely on monitoring to assess the impact of congestion and delay.

Content Delivery Networks (CDN) and caching

7.34 There are a number of specialist providers of services that deliver content from service providers to providers of IAS and their customers[84]. Such CDNs offer a cost-effective way of routing content avoiding the need for expensive transit or peering arrangements. Some of the largest content providers now operate their own delivery networks, in some cases replacing their previous use of independent CDNs, which must interconnect with ISPs in order to deliver content to consumers. They can do this either by paying a transit network, which itself connects to the ISP, via peering agreements or by interconnecting directly as shown in Figure 34. Direct interconnection is cheaper (for both the content provider and ISP) for the delivery of large volumes of data.

Figure 34: Approaches to interconnection



Source: Ofcom

[84] Examples include Akamai and Limelight.

7.35 Netflix's CDN arrangements, and those of other leading content providers, are now being further extended into the access provider's own network using 'caching servers'. Caching servers are CDN servers which can be placed within the ISP's network or on a third-party network, storing the most popular content. This removes the need for the ISP to connect to the original source of the content every time a customer requests it.

7.36 The local delivery of content can result in better delivery times to the consumer, which may translate to a better quality of experience, and so is often a preferred option for content providers. This approach further reduces transit or core connectivity costs, and can also improve the customer experience by reducing the likelihood of data congestion in these parts of the network. The commercials in this model are likely to include location services and port-based pricing.

7.37 We continue to review the arrangements for collocation space within the ISP's network to ensure it allows for equitable access to the space and power and that the peering policy does not discriminate against smaller CDN providers.

7.38 Many content providers are now measuring and reporting on the performance of their content through each ISPs network.[85] The publishing of this data on their websites may also influence how ISPs choose to interconnect with them.

Overall Trends

7.39 Continuing on from our 2016 report, use of CDN is increasing, through a mixture of self-build and operated CDNs and a vibrant commercial market place. This growth is further supported through leading generalist cloud service providers offering CDN solutions.

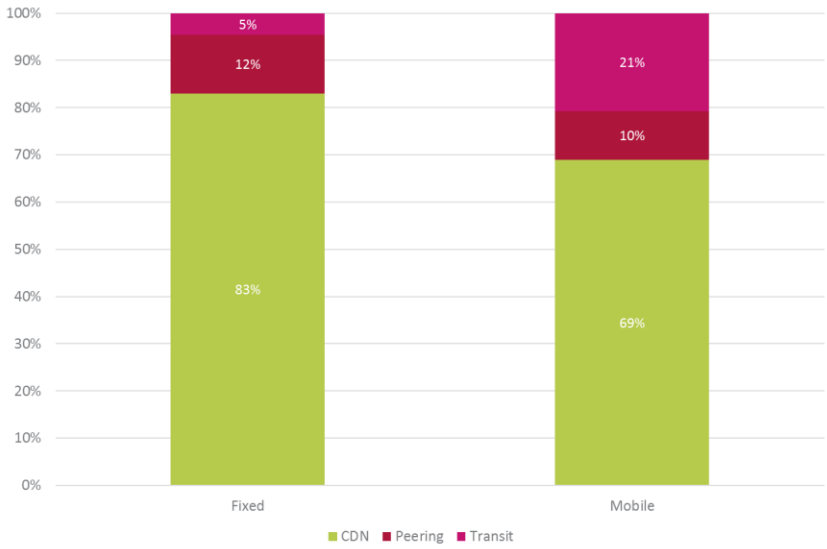
7.40 Although growth in internet traffic is being driven predominantly by video delivery, CDNs are used to deliver a wide range of content types such as consumer and enterprise web applications, software delivery, music and support for dynamic web pages.

7.41 Volumes of traffic across the interconnection points between the main ISPs and the internet core, other ISPs and the main providers of content have increased by around 53% since last year.

7.42 As Figure 35 shows, CDN connectivity continues to provide large proportions of the overall traffic than before. Generally, mobile networks have a lower proportion of CDN delivered traffic, probably reflecting the lower consumption of streamed video through devices connected directly to the mobile networks (as opposed to wifi) and the smaller size of the of streams and data.

[85] Such as https://ispspeedindex.netflix.com/country/uk/

Figure 35: Breakdown of fixed and mobile interconnection



Source: Ofcom analysis of operator data

Migrating to IPv6

7.43 Support for IPv6 continues to progress with many ISP and mobile operators either operating a dual stack approach or executing on plans to deploy IPv6. To further promote the adoption of IPv6, a working body (UK IPv6 Council) has been formed to address technical and business issues with a clear goal of promoting adoption.[86]

7.44 According to Asia Pacific Network Information Centre (APNIC), the Asian internet registry and leading reporter on IPv6 adoption, the UK is currently in 9th place[87] in the list of countries who have adopted IPv6. However according to the APNIC report only 24.63% of traffic is currently IPv6 routed.

Figure 36: IPv6 Allocations & Reachability

	IPv6 addresses (thousands /48)		
Year	**Allocated**	**Reachable**	**% Visibility**
2014	344,588	235,078	68%
2015	408,617	253,624	62%
2016	485,622	264,987	55%
2017	1,114,178	294,715	26%

Source: RTFM Report for Ofcom – 2017 Analysis of UK IPv4 and IPv6 address usage[88]

[86] http://www.ipv6.org.uk/
[87] https://labs.apnic.net/dists/v6dcc.html
[88] https://www.ofcom.org.uk/research-and-data/technology/internet-wifi/ipv6

7.45 As of June 2017, the UK internet registry (RIPE) is reporting IPv6 visibility within UK registered community at 26% of over 1 billion /48 subnetworks addresses assigned to the UK.

7.46 For example, Sky has progressively enabled 'dual-stack'[89] IPv6 which has resulted in a 91.77% of users now routing IPv6. BT who has also been enabling IPv6 has now reached a point where 24.06% of its base is IPv6 capable. We anticipate seeing BT and other operators' IPv6 routing to grow over the next 12 months.[90]

7.47 While the move to IPv6 is the long-term target for all providers, the use of IPv4 will continue for many years. Reviewing the allocated and assigned address space from UK providers, our current view is that there will be no significant issues with serving customers through the IPv4 address space due to:

a) MNOs' use of carrier grade network address translation (CGNAT)[91];

b) New mobile services, such as VoLTE are already using IPv6, and IPv6 will be further supported by new handsets supporting dual stack and IPv4/6 translation services, e.g. 464XLAT[92] ;

c) Fixed operators report plans for mitigating IPv4 exhaustion through CGNAT and use of the secondary market for address space.

7.48 Figure 37 highlights the allocated and assigned IPv4 address space for the UK.

Figure 37: UK IPv4 address space

	Allocated IPv4 addresses (thousands)	Reachable IPv4 addresses (thousands)	% Reachable
2014	69,541	57,711	83%
2015	69,835	58,287	83%
2016	70,226	58,194	83%
2017	70,566	59,111	84%

Source: RTFM Report – 2017 Analysis of UK IPv4 and IPv6 address usage

[89] http://www.ipv6.org.uk/
[90] https://stats.labs.apnic.net/cgi-bin/v6pop?c=GB
[91] Carrier Grade Network Address Translation is a technology that allows many end-users within a communications network to share public Internet Protocol addresses.
[92] This allows devices on IPv6-only networks to access IPv4-only Internet services. https://tools.ietf.org/html/rfc6877