



Traffic Management and 'net neutrality'

A Discussion Document

Discussion

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Section 1

Executive Summary

- 1.1 The internet is increasingly central to the lives of citizens, consumers and industry. It is a platform for the free and open exchange of information, views and opinions; it is a major and transformative medium for business and e-commerce, and increasingly a mechanism to deliver public services efficiently. As such it provides access to a growing range of content, applications and services which are available over fixed and wireless networks.
- 1.2 Many of these services, particularly those which contain video content, require high capacity networks to deliver them. Some networks are already experiencing congestion problems as consumers use 'bandwidth hungry' services. Even in the longer term, as next generation networks are deployed, there may continue to be congestion problems particularly in wireless networks.
- 1.3 In response, network operators and internet service providers (ISPs) are making greater use of traffic management techniques. These can allow them to handle traffic more efficiently, to prioritise traffic by type, to charge for guaranteed bandwidth or to block or degrade the quality of certain content. Whilst traffic management potentially offers some benefits to consumers there are also concerns that firms could use traffic management anti-competitively. The increasing use of traffic management also raises questions about consumers' awareness and understanding of the impact that traffic management has on their broadband service.
- 1.4 There is growing international interest as to whether, and to what extent, traffic management should be subject to regulation. Countries including the US, Canada, Norway and France are considering adopting 'regulatory requirements in this area. On the 17 June the Federal Communications Commission (FCC) began a public process to consider possible frameworks for addressing the high-speed connections most consumers use to access the internet. This includes consulting on options to ensure consumers have access to relevant information about their broadband services and for preserving the open internet.
- 1.5 Proponents of 'net neutrality' argue that traffic management by network operators and ISPs could lead to discrimination, in turn harming what they see as essential features of today's internet . The debate ranges widely including questions such as whether citizens have a 'fundamental right' to a neutral internet, or whether 'net neutrality' promotes economic competitiveness and growth. These are important questions, but also ones primarily for governments and legislators.
- 1.6 In Europe the revised European Framework for Electronic Communications Regulation (the Revised Framework) includes some specific changes to legislation designed to prevent the degradation of services and the hindering or slowing of traffic. The revisions, once implemented by the UK Government, will introduce more specific requirements for greater transparency. They will also provide for the UK Government to empower Ofcom to impose a 'minimum quality of service on the internet'. The European Commission has announced that it will publish a consultation on net neutrality soon.
- 1.7 Against the background of this wider debate, traffic management raises two key questions for Ofcom, in relation to our duty to promote the interests of citizens and consumers in carrying out our functions. These are:

- i) What stance should Ofcom take on any potential discrimination?
 - ii) What is the best way to deliver consumer transparency?
- 1.8 The purpose of this document is to initiate an open discussion with all our stakeholders as to how our existing and prospective powers under the Revised Framework due to pass into UK law in 2011 might be used in the UK to address traffic management concerns.

Traffic management and discrimination

- 1.9 At the heart of the traffic management and net neutrality debate, is a concern that traffic management could be used as a form of anti-competitive discrimination. To date Ofcom has received no formal complaints from industry that require investigation. But we are aware of areas of disagreement between network providers and ISPs and some content, applications and service providers.
- 1.10 We believe the potential anti-competitive effect of discriminatory traffic management policies may be a valid concern and relevant for consideration as part of our general duty to promote competition.
- 1.11 Generally speaking, our initial position is that discriminatory behaviour is only a potential issue where firms have substantial 'market power' and could discriminate in favour of their own services¹. In this case, any form of discrimination will come under very close scrutiny to ensure that there are no anti-competitive effects. We believe that there is insufficient evidence at present to justify the setting of blanket restrictions on all forms of traffic management.
- 1.12 The Revised Framework also provides for the UK Government to empower Ofcom to impose a minimum quality of service. In that event there are a number of approaches we could take but it is likely that our initial view would be to explore existing competition tools and consumer transparency options before considering a minimum Quality of Service.
- 1.13 We welcome stakeholder views on both the nature of any potential anti-competitive discrimination in the market, appropriate regulatory remedies, if any, and initial views on the appropriateness of imposing a minimum quality of service.

Consumer Transparency

- 1.14 Traffic management presents two potential challenges for consumers. Firstly, when comparing different services consumers might find it difficult to understand the various traffic management policies and the impact that these policies would have on their user experience (for example on the content, services and applications they may want to access). Secondly, consumers might find it hard to understand the impact that any *changes* to their existing provider's traffic management policy would have on their internet experience.
- 1.15 We believe that a lack of transparency in this area may already be an issue for consumers. The potential for consumer harm could increase as traffic management becomes more widely deployed and more sophisticated.

¹ Given the nature of this discussion document, market power is considered as a broad conceptual principle. We do not seek to assess the relevant product and geographic markets where such market power may arise.

- 1.16 Consumer transparency is an issue of global interest with initiatives taking place in a variety of countries.
- 1.17 The European Commissioner, Neelie Kroes, has recently stated that consumer transparency of traffic management is 'non-negotiable'². We agree and consider that it is critical that consumers are appropriately informed of traffic prioritisation, degradation or blocking policies being applied by their ISP and that they are able to factor these in when making purchasing decisions.
- 1.18 Effective consumer transparency requires information to be meaningful to consumers. Simply providing information will not enable consumers to make informed purchasing and switching choices if it is not the right type of information, and is not presented in a way that is useful. We think that it is important that industry works together to find creative and effective solutions for delivering consumer transparency. We recognise that it would be important to track and evaluate the impact of these consumer transparency approaches.
- 1.19 However, a failure to provide the transparency required for consumers to make informed choices is likely to increase pressure for introducing potentially more prescriptive policy options provided for by the Revised Framework, such as a minimum quality of service.

The role of this document and next steps

- 1.20 In this discussion document we consider the key issues and set out our initial thinking on net neutrality and traffic management. Ofcom is seeking views on the issues raised. To help stimulate debate we set out a number of questions at the end of this executive summary.
- 1.21 We will conduct a series of roundtables with industry, citizen and consumer groups over the summer and we encourage interested parties to participate in these discussions.

Questions for discussion

- 1.22 We are seeking views on a range of questions and require responses by the by 9 September 2010. This will allow us to take these views into account when we input into the European Commission's Consultation (expected to conclude by the end of September). The questions are set out below:
- i) How enduring do you think congestion problems are likely to be on different networks and for different players?
 - ii) What do you think are possible incentives for potentially unfair discrimination?
 - iii) Can you provide any evidence of economic and or consumer value generated by traffic management?
 - iv) Conversely, do you think that unconstrained traffic management has the potential for (or is already causing) consumer/citizen harm? Please include any relevant evidence.

² A conference in Paris on 13 April 2010
<http://europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/10/153>

- v) Can you provide any evidence that allowing traffic management has a negative impact on innovation?
- vi) Ofcom's preliminary view is that there is currently insufficient evidence to justify *ex ante* regulation to prohibit certain forms of traffic management. Are you aware of evidence that supports or contradicts this view?
- vii) Ofcom's preliminary view is that more should be done to increase consumer transparency around traffic management. Do you think doing so would sufficiently address any potential concerns and why?
- viii) Are you aware of any evidence that sheds light on peoples' ability to understand and act upon information they are given regarding traffic management?
- ix) How can information on traffic management be presented so that it is accessible and meaningful to consumers, both in understanding any restrictions on their existing offering, and in choosing between rival offerings? Can you give examples of useful approaches to informing consumers about complex issues, including from other sectors?
- x) How can compliance with transparency obligations best be verified?
- xi) Under what circumstances do you think the imposition of a minimum quality of service would be appropriate and why?

Section 2

Ofcom's role and responsibilities

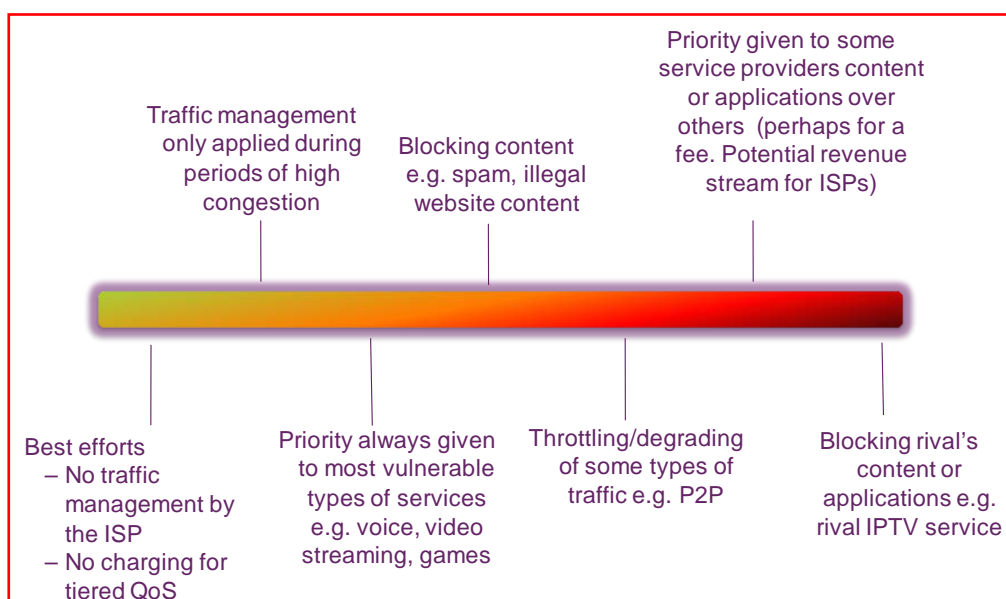
Introduction

- 2.1 This discussion document sets out our initial thinking on traffic management and net neutrality and aims to contribute to the net neutrality debate taking place amongst governments, industry and consumers. As the UK's communications regulator, we focus on the issues that directly relate to our current regulatory duties and those that potentially arise after implementation of the Revised Framework.
- 2.2 In this chapter we outline the key issues surrounding net neutrality and traffic management and why the issue is relevant to consumers. We then explain Ofcom's role in the debate under our current legislative framework and how this might change in the future when the Revised Framework is transposed into UK law.

What do we mean by traffic management and 'net neutrality'?

- 2.3 The term 'traffic management' refers to a range of different techniques that network operators and ISPs use when they think there is a need to either restrict or ration traffic or give priority to some types of traffic over others.
- 2.4 There are various definitions of 'net neutrality'. All see discrimination by network operators and ISPs between traffic as the core problem which 'net neutrality' policies should address. The purest version of 'net neutrality' assumes that:
- there should be no prioritisation of any type of traffic by network operators; and
 - those providing content, applications and services via the open internet should not be charged by network operators/ISPs for the distribution of that content to the network operator/ISPs' customer base.
- 2.5 In practice though many advocates of 'net neutrality' argue for a more nuanced policy than this. The debate has focused on whether network operators and ISPs should be allowed to block or degrade traffic using traffic management techniques, or (conversely) charge consumers, service providers or both for a certain guaranteed quality of service.
- 2.6 We think it is helpful to think of traffic management techniques as a continuum as illustrated in Figure 1.

Figure 1: The Traffic Management Continuum



- 2.7 Some traffic management is already taking place. It is common practice by some ISPs to manage the bandwidth of users during periods of high network congestion or when a subset of subscribers uses a disproportionate share of overall capacity, to the detriment of other users. Traffic management is also necessary to help ensure that limited internet capacity is optimally used to satisfactorily deliver a diverse range of services for example by assigning lower priority to traffic which is less sensitive to IP packet losses and delays (such as email) and higher priority to live video or voice traffic.
- 2.8 Traffic management per se is neither good nor bad. For example, it is widely accepted that the blocking of illegal content (such as images of child abuse) is necessary and that steps taken to address issues such as online copyright infringement would be viewed as acceptable traffic management. It can also have important benefits for consumers, through avoiding congestion problems and ensuring that certain types of time sensitive applications are given priority.
- 2.9 But some types of traffic management may be considered problematic for consumers and some techniques, such as Deep Packet Inspection (DPI), may also raise data protection and privacy concerns. These fall outside of the scope of this document but we propose to work closely with the Information Commissioners Office to consider these issues.

How could traffic management affect citizens and consumers?

- 2.10 For consumers no traffic management means that their use of the internet will not be deliberately altered by the network operators or ISPs. In principle, this allows them to enjoy open access to all content and services on the internet but in practice it comes with a risk of their bandwidth becoming congested at peak times with the result that certain applications (e.g. online video) are slowed down or degraded. This is particularly likely to be a problem for mobile networks.
- 2.11 At the other end of the continuum network operators and ISPs could seek to restrict certain types of applications. For consumers this might reduce their access to online content and services if exclusivity deals are struck or a rival's content is blocked. For

example, their use of some services, e.g. VoIP calls may be restricted. Network operators and ISPs might be able to offer consumer benefits as a result of this curtailed choice, perhaps promising to deliver their own services at a certain level of quality, for example offering high definition video without interruption.

- 2.12 Between these two extremes lie other hypothetical models with different consumer outcomes and it is possible that several of these could co-exist, Some companies might choose to restrict traffic, perhaps to ease congestion, whilst others may offer open and unrestricted 'best effort' access. Alternatively network operators and ISPs could seek to charge consumers on a tiered basis e.g. offering a maximum broadband speed and a good quality of service, while guaranteeing enough bandwidth for applications such as video.
- 2.13 This discussion document will return to a number of these outcomes in later chapters. In all cases consumers will need meaningful and transparent information to understand what they are being sold.
- 2.14 Traffic management raises citizen issues. An increasing number of Government departments and agencies are putting forms and information online. In the future this may extend to video content that explains important public information. Publicly funded institutions are also using the internet to distribute their content and services, for example the BBC iPlayer. Access to broadband is therefore becoming an important way to access public services and traffic management could potentially have an impact on how citizens might access these services in the future.
- 2.15 The internet is also a powerful communication medium which can facilitate personal expression, creativity, political participation and social activism (e.g. through social network sites). It has been argued that internet access should be recognised as a fundamental right since it has become necessary to take full part in a modern democratic society³. Some observers fear that traffic management could unduly restrict such activities, which are recognised to be of high social value.
- 2.16 Broadband access has also been linked to wider public policy issues such as education, industrial policy and innovation. Julius Genachowski, Chairman of the Federal Communications Commission (FCC), has stated that "History's lesson is clear. Ensuring a robust and open internet is the best thing we can do to promote investment and innovation,"⁴ However critics have argued that net neutrality will stifle innovation as it will restrict investment in new services if network operators are unable to receive a return on their investment.
- 2.17 In the UK superfast broadband has been identified as a priority by the Coalition Government in their Programme for Government.

Ofcom's role in relation to traffic management and 'net neutrality'

- 2.18 We acknowledge these wider political and public policy considerations around broadband access and recognise the link to traffic management. However, questions of fundamental rights and industrial and public service policies are beyond the scope

³ The Revised Framework (Amending Directive 2009/140/EC, Recital 4 and Art 1(3) of the amended Directive 2002/22/EC and amended Directive 2002/21/EC) states that the internet is essential for education and exercising the freedom of expression³. It further states that restrictions on the access to the internet should respect the fundamental rights and freedoms of natural persons but does not go so far as to recognise it as a fundamental right itself.

⁴ <http://www.openinternet.gov/read-speech.html>

of this discussion document as they are matters for Government and this document focuses on Ofcom's current regulatory responsibilities and any future duties under the Revised Framework. However, an awareness of this wider debate is necessary to inform why traffic management is important to both citizens and consumers.

- 2.19 The broad outlines of a European policy approach which factors in these various considerations can already be identified from the Revised Framework⁵(which is discussed later on in this section). The European Commission will continue to examine the 'net neutrality' issue and is due to publish a consultation document soon. We expect the focus of this document to be on the broader public policy dimensions of 'net neutrality'.
- 2.20 Against this background, Ofcom believes that it is important to be clear on what is an appropriate role for the regulator to play both in terms of our powers as they stand today, and in the light of any changes to those powers following transposition of the Revised Framework.

Our relevant functions and duties today

- 2.21 A summary of some of our relevant existing functions is set out below:
- 2.21.1 Under the current framework⁶ Ofcom can set transparency requirements for suppliers to provide certain consumer information on access to the internet through imposing General Conditions. Ofcom can also set obligations on operators to ensure end-to-end connectivity and impose fair, reasonable and non-discriminatory SMP access conditions which could specify the terms and conditions for access.
- 2.21.2 Ofcom has concurrent *ex post* competition law powers with the OFT under the Competition Act 1998 and Enterprise Act 2002 respectively, to deal with activities connected with communications matters and commercial activities connected with such matters.
- 2.21.3 Under the Unfair Terms in Consumer Contracts Regulations: these apply to all consumer contracts, and include provisions under which obscure or hidden terms, or changes in the contract without a valid reason, may be unfair.
- 2.21.4 Section 3 of the Communications Act 2003 states that Ofcom's principal duty in carrying out its functions is to further the interests of citizens in relation to communication matters, and to further the interests of consumers in relevant markets, where appropriate by promoting competition.

⁵ Included in Recital 4 of Directive 2009/140/EC

⁶ The current framework includes a package of the following four directives:

- Directive 2002/20/EC on the authorisation of electronic communications networks and services (the "Services Directive");
- Directive 2002/21/EC on a common regulatory framework for electronic communications networks and services (the "Framework Directive");
- Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services (the "Universal Services Directive" or "USD"); and
- Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector (the "Privacy Directive").

These were implemented in UK Law in the form of the Communications Act 2003 on 25 July 2003.

- 2.22 There is no doubt that in principle, the 'citizenship' aspect of our primary duty could come into play as a result of the deployment of traffic management. In the US debate on net neutrality, it has for instance been argued that this will lead inexorably to a closing down of the 'open' internet as we know it today in favour of a series of closed platforms tightly controlled by telecoms operators.
- 2.23 The deployment of traffic management techniques is therefore relevant to our functions and duties for a number of reasons, including:
- Traffic management techniques could lead to discrimination by fixed or mobile ISPs with market power in favour of their own applications, content and services, thus harming both competition and consumers, who benefit from an open and competitive market structure.
 - Even if not engaging in overt discrimination, traffic management could be deployed by firms with market power in a way that harms consumers, for instance by setting wholesale or retail prices for guaranteed quality of service too high.
- 2.24 Traffic management techniques also raise consumer concerns when their use is not clear or, even where explained, it may be technically complex and difficult for many consumers to factor into their purchasing and/or switching decisions.

Changes to our functions and duties under the Revised Framework

- 2.25 The European Commission launched a review of the Framework in 2007 and the European Parliament and the Council of Ministers reached an agreement on a package of new rules in November 2009 (the "Revised Framework"). These were published in December 2009 and are to be transposed by Member States into national law by 25 May 2011.
- 2.26 The broad outlines of the European approach seem to us to be as follows⁷:
- There is a strong presumption in favour of preserving the 'open and neutral character of the internet'⁸ to promote the right of consumers to access and distribute information.
 - However traffic management services are neither mandated nor prohibited. Any such measures must:
 - respect national and community law;
 - be appropriate, proportionate and necessary; and
 - be transparent.
- 2.27 The Revised Framework is an update of the previous Framework and the amended Directives are as follows:

⁷ See Directives specifically amending directive 2009/140/EC recital 4, Art 1(3) of the amended USD and FWD

⁸

<http://europa.eu/rapid/pressReleasesAction.do?aged=0&format=HTML&guiLanguage=en&language=EN&reference=MEMO/09/513>

- Directive 2009/140/EC (the "Better Regulation Directive")⁹ which amends the Framework Directive, the Access Directive and the Authorisation Directive.
- Directive 2009/136/EC (the "Citizens' Rights' Directive")¹⁰ which amends the USD and the Privacy Directive.

2.28 As noted above, the Revised Framework seeks to provide Member States with additional regulatory powers with regards to traffic management and give additional clarity to National Regulatory Authorities (NRAs) as to their role in relation to traffic management and discrimination. Generally, it recognises and safeguards the basic freedoms of internet users requiring NRAs to promote "the ability of end-users to access and distribute information or run applications and services of their choice"¹¹.

2.29 Specifically, the new rules:

- Provide potentially stronger and more explicit transparency measures in relation to information available to consumers to enable them to make informed choices.
- Provide Governments with the ability to empower NRAs to set minimum quality of service requirements on public electronic communications network operators.

2.30 Our interpretation of how the Revised Framework updates our functions and duties is subject to discussion with the UK Government which is ultimately responsible for interpreting and implementing the provisions.

Conclusions on Ofcom's role

2.31 It is clear that Ofcom already has a relevant role in relation to the deployment of traffic management. However, the Revised Framework when implemented into UK law may both expand and clarify that role.

2.32 Equally, it is clear that the common understanding within the EU is that 'an open and neutral internet' is a desired outcome which may be achieved through a range of regulatory measures, not least appropriate forbearance from regulation. There is no obligation on national regulators to introduce restrictions on traffic management or other forms of network management. We do however need to consider carefully how our potentially expanded consumer transparency powers would apply.

2.33 The consultation being initiated by the European Commission this summer could lead to a fresh debate about the need for a more radical European 'net neutrality' policy.

⁹ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:337:0037:0069:EN:PDF>

¹⁰ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:337:0011:0036:En:PDF>

¹¹ Article 8(4)(g) of the Framework Directive as amended by Article 7b of the Better Regulation Directive

Section 3

The debate and why it is happening now

Introduction

3.1 In this chapter we look at why the debate is escalating and why it is therefore timely for Ofcom to examine its position on traffic management and 'network neutrality'. This section provides a brief overview of the evolving structure of the internet and its associated value chain and considers:

- the impact of market developments and changing consumer behaviour; and
- the way in which the debate is evolving internationally and in the UK.

Market developments are putting pressure on the 'best efforts' approach

3.2 The internet has developed as an open 'network of networks', with some fairly simple rules operating as to how internet traffic is conveyed. There has been a 'best efforts' approach to managing network traffic whereby networks attempt to convey all traffic more or less on equal terms. Some important exceptions to this rule already exist within the internet which is not truly 'neutral' even today. The predominant 'best efforts' approach is under increasing pressure. Partly this is simply a function of increasing capacity demand - global internet traffic continues to increase by 40% each year, and despite ongoing investments in infrastructure it is causing congestion in the internet delivery chain – but also because services are developing which are both bandwidth-heavy and highly delay-sensitive.

3.3 Network operators and ISPs are responding to demand for higher-bandwidth by starting to invest in upgrading their physical 'access networks' which provide the last mile connections to consumer households to make them fit for purpose for this new world. For example, here in the UK, Virgin media has deployed 'up to' 50Mbits fibre-based broadband and is piloting speeds of 200Mbits and BT has announced its intention to make its super-fast broadband available to 66% of the UK by 2015. These are driving up both the speed available but also the amount of internet capacity used which will require an increase in capacity in the backhaul and internet core. Without complimentary investment in these parts of the network, congestion problems will intensify.

3.4 In contemplating the scale of investments required not just in access but also in backhaul, network operators and ISPs are also considering whether traffic management techniques could play a role as a complement or substitute to network investment.

3.5 The traffic management debate is also moving up the agenda due to the profound structural changes occurring in three closely related industries: the telecommunications sector, the content market and the online sector.

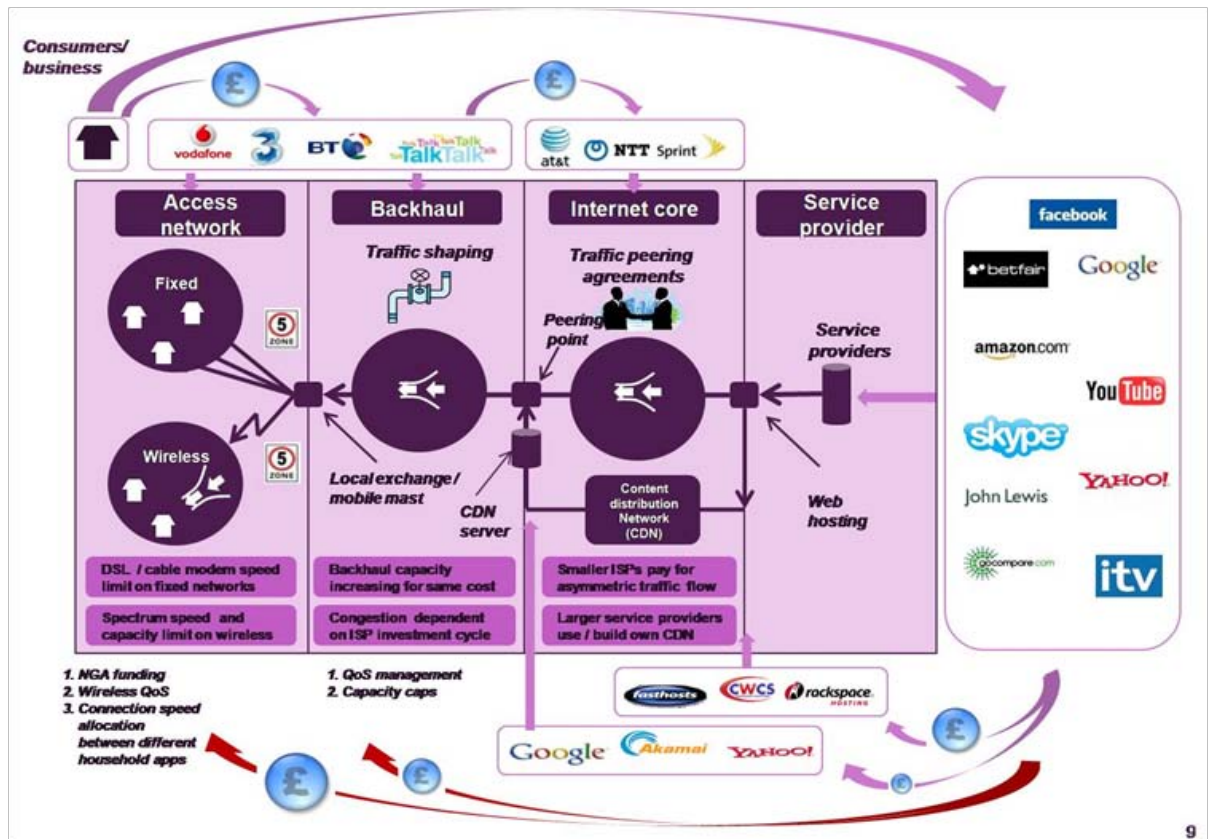
The telecommunications sector

3.6 The telecommunications sector has undergone a transition from the old world of conventional telephony to a new environment in which broadband connectivity makes

new services and applications (and associated revenues) possible. Critical to understanding the 'net neutrality' debate is that this change is bringing the telecommunications industry into an expanded 'value chain' in which consumers increasingly use telecommunications networks as a jumping off point for a vast array of e-commerce and entertainment services, many of which are delivered over the open internet and involve a large cast of market participants.

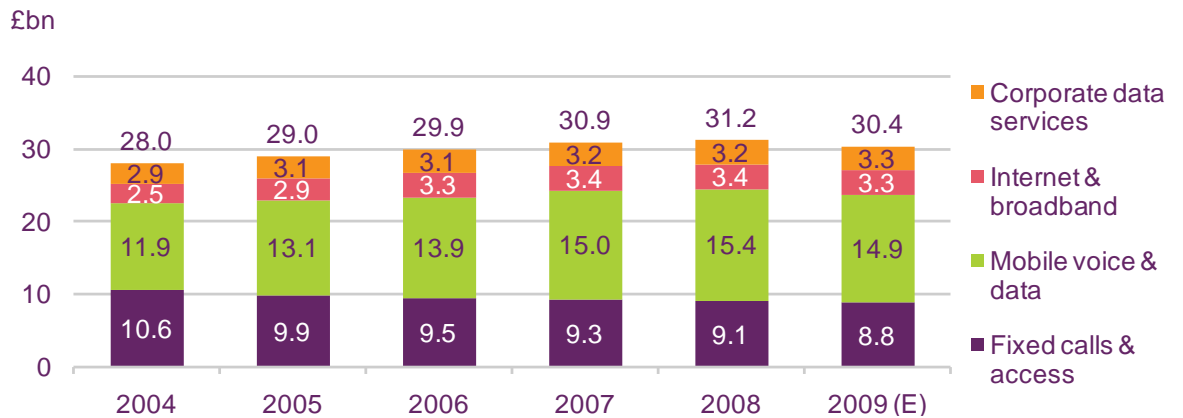
3.7 Figure 2 illustrates the different actors and the inter-relationship between them in the internet distribution chain (the operation of this chain is described in more detail in annex 1)

Figure 2: The Changing Shape of the Internet



3.8 New opportunities are not enough to offset the decline in traditional fixed and mobile telephony revenues, as Figure 3 illustrates.

Figure 3: UK Telecoms Industry Retail Revenue.

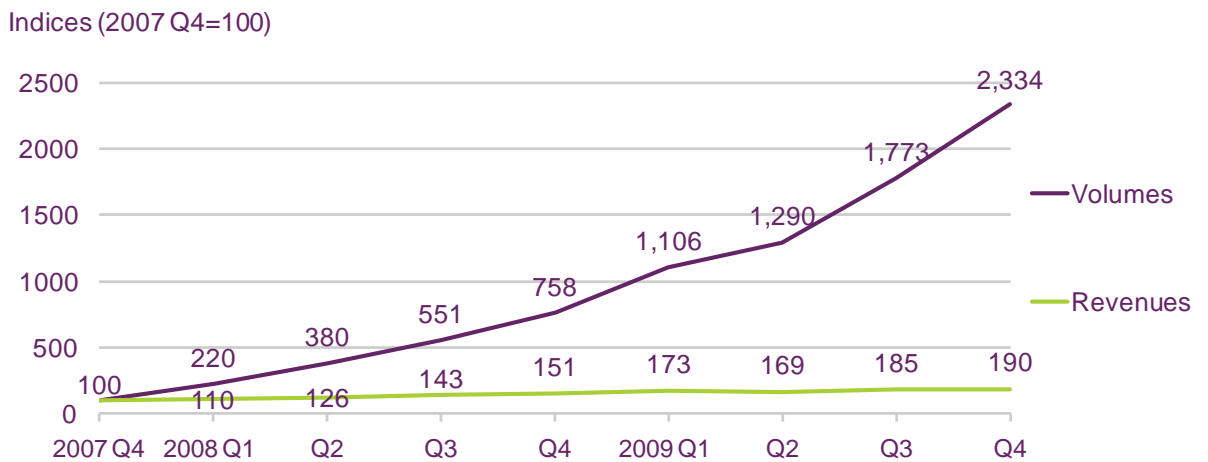


Source: Ofcom/ operators

Note: Includes estimates where Ofcom does not receive data

3.9 In mobile the issue is especially pressing due to the explosion of traffic on mobile networks over the last few years. As shown in Figure 4 below, in the two years since Q4 2007 mobile internet volumes have increased by over 2300 per cent but revenues have not even doubled. In a recent report, Morgan Stanley¹² argues that within five years more users will likely connect to the internet via mobile devices than via desktop PCs.

Figure 4: Growth in mobile data volumes and revenues



Source: Ofcom/ operators

Note: Includes estimates where Ofcom does not receive data from operators

3.10 On wireless access networks the spectrum allocated to each transmitter cell is shared by a number of different users and hence unlike fixed networks they do not provide a dedicated connection for each subscriber. This means that both the quality and speed of each user's internet connection is dependent on the other wireless

¹² http://www.morganstanley.com/institutional/techresearch/mobile_internet_report122009.html

users' use of the wireless access network capacity at the same time. A range of different approaches can be taken to improve the capacity and performance of wireless networks including the use of more spectrally efficient technical standards such as LTE, the use of smaller transmitter cells and offloading wireless network traffic onto fixed networks using Wi-Fi hot spot connections. Despite these measures the rapid growth in wireless internet traffic driven by Smartphone applications and wireless PC dongles means that wireless access networks seem likely to face greater capacity and speed constraints than fixed access networks. Therefore, there is an increasing challenge for network providers to reconcile the growing gap between rising data use, the consequent need for large-scale investment in both access and backhaul, and flat access revenues.

Development of traffic management technologies

- 3.11 The backhaul part of an ISP's network connects the local access networks to the internet core and is typically provided using fibre optic connections. The backhaul carries consolidated traffic from a large number of ISP subscribers and can become congested during times of peak internet demand. The level of backhaul congestion varies between different ISPs and is typically dependent on the timing of a particular ISP's investment in additional backhaul capacity to meet the increased internet capacity demands of its customers.
- 3.12 As noted above traffic management is already taking place in the network to manage the bandwidth of users during periods of high network congestion or when some subscribers are using a disproportionate share of overall capacity to the detriment of other users. Network providers and ISPs can make use of traffic management for a range of other purposes, for example:
- To ensure that limited internet capacity is optimally used for example by assigning higher priority to traffic more sensitive to IP packet losses and delays (e.g. live video or voice traffic).
 - To enable new sources of revenue, for instance by allowing operators to charge consumers for guaranteed bandwidth for a fixed period of time – for instance, a three hour slot to stream a movie.
 - To guarantee a particular quality of service for a particular type of content, service or application. If operators were to charge for this it could create a new income stream for network operators.
 - To block or degrade content, applications or services.
- 3.13 There are a number of technical and non-technical ways in which internet traffic is or could be managed in the future. Some of these are outlined below:
- The Transmission Control Protocol is one of main internet protocols and it is used to manage end-to-end connections across the internet in a bit neutral way. It remains the most important means of managing congestion on the internet by moderating individual flows of traffic.
 - Using DPI internet traffic can be analysed and classified according to the type of service it is delivering. This can then be used to limit different classes of traffic that are believed to create congestion, or to block illegal content.

- Network operators/ISPs could impose volume caps that limit the total volume of traffic over different times both in relation to upstream and/or downstream traffic.
- Network operators/ISPs could set how the broadband connection speed available to a particular household¹³ is allocated between internet services being accessed by different members of the household at the same time.

3.14 With the relevant traffic information, ISPs and network operators can prioritise subscribers or application traffic based on range of factors such as the amount of internet traffic used during peak periods.

Content industries

3.15 The traditional content industries are also facing profound structural change. Traditional forms of content delivery, such as free-to-view television and newspapers, are coming under increasing pressure partly as a result of emergent competition for audiences and advertising from multi-channel television and online.

3.16 Many traditional content providers are developing their own broadband distribution strategies, most notably through the development of on-demand platforms and services. For example the BBC's iPlayer, ITV play, 4oD, Demand five and Sky Player.

3.17 Some content aggregators have started to deliver content directly to the set-top-box or the computer through a broadband connection. They have struck content deals with particular upstream content providers, but are not tied to a particular internet service provider (e.g. Fetch TV). These are sometimes described as "over-the-top" offers. As the range of devices able to support over-the-top delivery proliferates, and as new business models develop and competition intensifies, it is possible that consumers will be able to access TV content from anywhere on the internet, through multiple devices.

3.18 Such services, particularly if delivered in high definition format, will inevitably consume considerable bandwidth.

3.19 By 2014 Cisco¹⁴ estimates that around 91 per cent of consumer internet traffic will be video related. That would mean an up to ten-fold increase in internet traffic volumes over the next four years. In addition, services like online gaming, mobile and cloud-based applications are increasing demand for capacity.

3.20 Many online service providers now use what is known as a Content Distribution Network (CDN) to move their content closer to the edge of the internet to prevent the quality of their services being impacted by traffic congestion in the internet core. These networks are best suited to distributing non-real time content services such as video-on-demand and web browsing. The content for these services is distributed and stored by the CDN operator on internet servers situated close to the end-user ISPs' networks. When consumers request content, it can then be delivered from a local server operated by the CDN provider, rather than a more remote internet server which would require the content to be delivered over the internet core. There are a

¹³ For DSL based broadband this speed is dependent on the distance of the consumer's household from the local exchange.

¹⁴

http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-481360.pdf

number of third party CDN providers such as Akamai and EdgeCast. A recent trend has been for larger service providers including Google and Yahoo! to build their own CDNs to deliver their content. In practice most CDNs circumvent only the effects of congestion in the internet core and not in the ISP's backhaul or access network.

- 3.21 Another recent trend has been for some ISPs to provide their own CDN solutions to service providers wanting to avoid congestion in these parts of the internet delivery chain as well as the internet core. These CDN solutions are of particular interest to video-on-demand service providers whose high capacity services are highly vulnerable to network congestion.
- 3.22 The investment in and development of CDNs is a major change in the architecture of the internet which is already seeking to deliver service quality by offsetting some of the problems of the 'best efforts' approach. To some degree, content distributors will face a choice in the future of whether to invest in CDNs or guaranteed quality of service delivery over 'edge' networks. These are starting to become complementary parts of the same process to guarantee quality of service, with the likes of Akamai and EdgeCast now peering directly with some large ISPs to provide a better end-to-end quality of service experience.

Online Sector

- 3.23 The online sector comprises an array of disparate businesses which have emerged in the first and second generation of internet development and whose business models have been based on the existence of a 'best efforts' internet.
- 3.24 This sector has a number of distinguishing characteristics including: low barriers to entry, short timescales for delivering new innovations to market, the global availability of content, applications and services, and rapid business cycles. These characteristics make the online economy a source of considerable interest to policy-makers, as such characteristics tend to be strongly associated with high levels of innovation and growth and hence economic competitiveness.
- 3.25 Online companies are also vulnerable to structural change. A striking feature of the internet economy has been not just the rapid growth but also rapid demise of internet brands. Major players are making attempts to expand beyond their traditional businesses into other parts of the value chain e.g. Google venturing into the mobile handset market and Amazon streaming video content. Inevitably this brings these firms into a closer and potentially more antagonistic relationship with network operators, ISPs and content providers.
- 3.26 As the telecommunications market, content sector and online sector change, points of friction will inevitably arise over who controls customer relationships and the rate of innovation. Firms across these sectors are also competing for a share of advertising revenues and consumers' expenditure at a time when there are concerns about the sustainability of many of the existing business models, not just for traditional telco and content distribution businesses but also a surprisingly large number of online businesses.
- 3.27 The debate must also be considered within the context of the developing market for IP-based audiovisual services, such as video-on-demand and online interactive gaming. Whilst network operators are exploring the use of technologies such as DPI to manage the flow of traffic across their network, content providers are experimenting with Digital Rights Management (DRM) as a means by which they can establish greater control over how their content is accessed, consumed, stored and

shared. As the value chain is taking shape, network operators and content providers are bargaining over how future rents will be divided and technical measures such as DPI and DRM are being deployed in part to strengthen relative negotiating positions. Some believe that measures such as DPI and DRM will create economic bottlenecks in the value chains, putting those who control access in a strong position to extract rents. Such technologies also enable the collection of data, both on the effective demand for particular pieces of content and on how particular consumers engage with the content. The data generated is in itself valuable currency, which can be sold to third parties as well as being used to target adverts or services based on behaviour. Control of that data is one reason why the competition between ISPs/network operators and content providers is so intense.

- 3.28 It is important for the regulator to take this wider set of changes into the value chain into account. Some of the analysis that we have seen assumes an essentially fixed relationship between ISPs/network operators and content providers. Clearly, this is not the case at present. In a period of considerable change, there are substantial dangers from premature regulatory intervention to support one part of the sector over another.

Consumer behaviour and demand for rich data could put more pressure on networks

- 3.29 In the UK broadband availability is reaching near-universal levels. Ofcom research shows that in Q1 2010 65% of UK households had a fixed broadband connection. Take up of mobile broadband has grown substantially in recent years. In Q1 2010 around 15% of the population had a mobile broadband connection.
- 3.30 Increased adoption of broadband has revolutionised consumer behaviour. Consumers are increasingly using broadband as a delivery platform for bandwidth hungry content such as audio-visual content.
- 3.31 Ofcom's publicly stated position on consumer transparency as set out in speeches and inputs during the review of the Framework, has been that consumers should be fully informed of any traffic prioritisation, degradation or blocking policies being applied by their ISP and therefore should be able to factor this in when making purchasing decisions (and well enough in advance of any changes) so that competition is effective at the retail level.
- 3.32 In practice this has been implemented for fixed ISPs via the Broadband Speeds Code¹⁵, though requirements are broad and high-level. However, it is clear that currently:
- consumer transparency is relatively poor;
 - information on traffic management policies can be difficult to find;
 - where information is available it can be difficult for consumers to relate this to their actual experience; and
 - it is therefore difficult for consumers to recognise if or where traffic management practices are impacting on their experience.

¹⁵ <http://www.ofcom.org.uk/consumer/2009/02/broadband-speed-guide/>

- 3.33 Consumers are increasingly aware of the extent to which traffic management is taking place and can materially impact on the quality of their experience when using internet-delivered services. First generation traffic management techniques which impose caps on the amount of data which consumers can download in a given period, or that routinely 'throttle' (i.e. restrict the peak data rates of) certain internet applications have already generated grass-roots comment and in some case criticism from user groups. We discuss these issues in more detail in Section 5.

The issue of 'net neutrality' and traffic management is high on international agendas

- 3.34 The debate around traffic management has an important international dimension. It arose initially in the **United States**, following the deregulation of wholesale access services, where consumer groups and major content, applications, and service providers expressed concerns about the possibility that network operators would be able to discriminate in favour of their own content activities and degrade that of rival services.
- 3.35 Although there have been few formal cases, two particular instances created most controversy: the Madison River case, where a local US telecoms operator, denied access to VoIP services to internet users and the Comcast case, where the cable operator prevented BitTorrent users from uploading files without informing its customers of the policy. In several European countries VoIP operators have publicly voiced concerns about being blocked or throttled by mobile networks, and about VoIP functionality being removed from mobile handsets.

The Comcast Case

In 2007 a number of customers and advocacy groups complained to the Federal Communications Commission (FCC) that Comcast was interrupting and degrading P2P traffic (and particularly BitTorrent traffic) on its network. An important element of the complaint was that Comcast had changed its policy on traffic management without informing its customers of such change.

In August 2008 the FCC requested Comcast stop what it described as "discriminatory network practices", arguing that they violated the FCC's "Internet Policy Statement". Prior to the FCC making a final decision, Comcast agreed to revise its network management practices but imposed a cap (250GB) on users. The FCC nonetheless decided to sanction Comcast for significantly impeding "consumers' ability to access the content and use the applications of their choice", and Comcast appealed the decision, questioning the FCC's authority to dictate network management practices.

In April 2010, the District of Columbia court of appeals ruled that the FCC lacked a sufficient statutory basis for its order, because it did not identify any express statutory delegation of authority. Following the ruling, the FCC released a statement in which it noted that it was firmly committed to "promoting an open internet and to policies [...] designed to foster innovation and investment while protecting and empowering consumers". While it admitted that the Court's decision invalidated their prior approach it stated that the Court did not "close the door to other methods for achieving this important end."

More recently, the FCC Chairman, Mr. Julius Genachowski has proposed a "Third Way" which aims at preserving the longstanding consensus that the FCC should not regulate the internet, including web-based services and applications, e-commerce sites, and online content. This is described as a narrow and focused solution that will provide solid legal foundations to push forward with their National Broadband Plan while preventing regulatory overreach.

- 3.36 Such frictions amongst industry players and consumers together with increased consumer awareness of and at times dissatisfaction with internet performance, have led communications regulators around the world to take a closer look at issues related to traffic management.
- 3.37 The FCC announced last September a proceeding to consider formally adopting the so-called Four Freedoms internet policy principles through which the FCC seeks to enforce 'net neutrality' requirements on providers of broadband internet access (these are: Freedom to Access Lawful Content; Freedom to Use Applications; Freedom to Attach Personal Devices That Do Not Harm the Network; Freedom to Obtain Service Plan Information Entitlement to Competition) and including two more principles¹⁶:
- i) **non-discrimination**: broadband providers cannot discriminate against particular internet content, services or applications, but may engage in reasonable network management; and
 - ii) **transparency**: providers of broadband internet access must disclose their network management practices to consumers, content, application, and services providers, and the FCC.
- 3.38 The rules were originally applied only to fixed broadband services, but the FCC clarified its intent to ensure that wireless services, such as data services provided to smartphones, be subject to the same principles, while recognizing that the application of those principles might differ across platforms.
- 3.39 In October 2009 the FCC published a draft "Notice of Proposed Rule Making" aiming to preserve an open internet. This has been subject to an extended period of consultation which is still ongoing, although the latest batch of comments was submitted in April.
- 3.40 In June 2010 the FCC opened a separate proceeding to determine the best way forward after a court decision in April 2010 cast serious doubt on the legal framework the commission has been relying on to support broadband policies, including open internet rules.
- 3.41 In **Europe**, the issue has also attracted attention, particularly during the review of the Framework. The Body of European Regulators for Electronic Communications (BEREC) has included net neutrality in its work programme for 2010, and is currently considering the issues that fall within the scope of the Revised Framework, with a view to provide input to the European Commission's own work. Other European regulators are planning to initiate some work in 2011, on the back of BEREC's analysis, or will be looking at this in the context of the implementation of the revised Framework. Some relevant examples of international activities are set out below.
- 3.42 **Norway**: In June 2008 following discussions with stakeholders the Norwegian communications regulator (NPT) initiated an external working group with stakeholders to discuss and agree on a set of guidelines on 'net neutrality'. The discussions led in February 2009 to a voluntary agreement on guidelines for net neutrality based on three principles:
- i) **transparency**: whereby internet users are entitled to a connection with a predefined speed and quality;

¹⁶ http://www.wired.com/images_blogs/epicenter/2009/10/fcc-09-93a1.pdf

- ii) **freedom of use:** whereby internet users are entitled to send and receive content of their choice, use services and applications of their choice and use software and hardware of their choice that do not harm the network; and
 - iii) **non-discrimination:** whereby, internet connections may not discriminate with regard to the type of application, service or content or based on the sender or receiver's address.
- 3.43 NPT has recently evaluated the guidelines based on feedback from stakeholders and concluded that they are applicable for mobile broadband as well.
- 3.44 **France:** The French communications regulator (ARCEP) decided in September 2009 to facilitate a wide public reflection on this matter. It conducted a series of public hearings (more than 50) with a multitude of operators, service providers, manufacturers, academics, and consumer/citizens organisations. These hearings (associated with a questionnaire) concluded at the end of March and were followed by a major conference hosted by the regulator in Paris. ARCEP also recently published initial policy directions on internet and network neutrality for consultation (closing 2 July 2010). These aim to guarantee "internet access" by users to all content, services and applications carried over the networks, in accordance with legal provisions in effect and in a transparent and non-discriminatory fashion, guarantee a satisfactory quality of service and enable the long-term development of networks and services. In parallel, the French Government launched a public consultation on net neutrality (which closed on the 17 May 2010) to better understand the various challenges and the potential consequences for the day-to-day use of the internet. This overview will inform a report due to the Parliament in June.
- 3.45 **Sweden:** The Swedish Post and Telecom Agency (PTS) was asked by the Swedish Government to produce a report on open networks and services. In its report¹⁷ published last November PTS concluded that:
- i) Openness creates the prerequisites for innovation and competitiveness but must be balanced against other interests worthy of protection, such as incentives to invest and network security; finding such balance is a challenge for regulatory authorities.
 - ii) Openness is promoted by securing non-discrimination and effective competition.
 - iii) Even if users appear to consider the differences between the various access technologies and operators to be reasonable, it is important that suppliers in their marketing activities and in applicable terms and conditions provide clear and specific information with respect to lock-in periods and restrictions relating to internet access and access to services.
- 3.46 Given the dynamic pace of the market, the report stated that a precautionary principle must be applied when intervening and that there was a need to consider the impact of intervention at one level of the value chain on other levels.
- 3.47 Although no specific legislative action has been taken, some regulators have introduced non-discrimination guidelines and looked at strengthening information transparency requirements. In **Canada**, for example, the Canada Radio-television and Telecommunications Commission (CRTC) issued a determination in October 2009 which concluded a series of public hearings initiated during the summer to

¹⁷ : <http://www.pts.se/upload/Rapporter/Internet/2009/2009-32-open-networks-services.pdf>

determine the latitude of ISPs to manage their networks (the review did not cover wireless data services).¹⁸

- 3.48 CRTC defended network investment as the primary solution for dealing with network congestion, but accepted the legitimate interests of ISPs to manage the traffic generated on their networks. It emphasised the need for strong consumer transparency requirements on operators about their internet traffic management practices that should be neither discriminatory nor unduly preferential, and introduced additional scrutiny for wholesale services.
- 3.49 Overall, the international regulatory debate has thus centred on issues of discrimination and transparency. It is worth noting, however, that the debate internationally strays beyond regulatory aspects around traffic management, covering wider political, industrial and social policy issues.

There is increasing interest in the issues among UK stakeholders

- 3.50 Increasing tensions caused by developments in a range of markets and changes in consumer behaviour have generated a number of public exchanges between parties about the principle of net neutrality and about specific traffic management issues. However, to date Ofcom has not received any formal complaints about traffic management from industry, and this also seems to be the case in the majority of other EU countries. So far consumer and citizen groups have remained largely silent on the issues.
- 3.51 However, it is clear that there are points of disagreement between players at different levels of the value chain over the deployment of 'bandwidth hungry' services on the one hand and the use of traffic management techniques that might degrade these services on the other hand. One example of this is the calls by certain ISPs for the BBC to make a contribution to the cost of carriage of iPlayer traffic.
- 3.52 The principal concern seems to be that network operators may block or deprioritise traffic from content providers who do not pay enough for the traffic costs they believe that the content providers give rise to.
- 3.53 To date the 'net neutrality' debate has been highly polarised with mobile communications providers (MCPs) and network operators and ISPs traditionally opposed to blanket 'net neutrality' and internet application providers arguing for 'net neutrality'.
- 3.54 However, while there remain a number of controversial issues, there appears to be increasing agreement that whatever the preferred approach, consumer transparency will be important.
- 3.55 In March 2010 the main stakeholders associations and key network companies in Brussels produced a joint paper supporting transparency for consumers; and arguing for smart, managed networks "to ensure a robust and efficient functioning of the

¹⁸ The review followed a complaint against Bell Canada by the Canadian Association of Internet Providers (CAIP) in 2008, relative to Bell's then newly extended practice of slowing down certain internet applications, specifically peer-to-peer software, to wholesale companies leasing portions of its network to provide their own services to customers. The regulator ruled that Bell's traffic throttling did not violate its wholesale obligations but concurrently launched the review to investigate a larger issue of network management and net neutrality.

network".¹⁹ In this document they stressed the importance of openness and transparency stating:

In support of the open internet, transparency for consumers regarding access to internet content, services and applications is key. In order to make informed choices, it is important that consumers are provided with clear and meaningful information about their ability to access or use internet services, applications and content.

- 3.56 Content providers are beginning to formulate their positions (e.g. The Motion Picture Association of America (MPAA) mostly agrees with the ISPs position and supports the use of network management to allow ISPs to implement anti-piracy networks.) Smaller content providers in the UK have yet to express a public view on traffic management but more are likely to do so as the debates surrounding net neutrality and traffic management continue. We are keen to hear their views.

Summary

- 3.57 This rising tide of interest in traffic management issues from UK and international stakeholders as well as the potential for consumer harm suggest that it is appropriate for Ofcom to revisit the question of where and how it might make use of its existing powers to address problems that might arise. In summary we consider it appropriate for Ofcom to consider these issues now for the following reasons:

- We need to revisit the question of where and how Ofcom might make use of its existing regulatory powers to address potential traffic management and 'net neutrality' issues.
- To be able to input as appropriate into BEREC's report on net neutrality and into the European Commission's consultation, taking into account the conditions of the UK communications market and the interests of UK citizens and stakeholders.
- To understand the potential implications for our stakeholders, UK consumers and Ofcom of potentially new and/or more specific duties set out in the Revised Framework.
- To provide technical input as appropriate into the UK Government's consultation on the implementation process.
- To plan our own work programme beyond the implementation date for the Revised Framework.
- To provide the necessary regulatory certainty for market players to consider the impact of any new policy on traffic management on investment and innovation.
- To continue to safeguard the interests of citizens and consumers in a rapidly evolving area.

¹⁹ The full document can be found at:

http://www.gsmeurope.org/documents/Delivering_openness_innovation_and_choice_for_consumers.pdf

- To ensure that the UK debate on these issues takes into account the specific characteristics of UK markets.

3.58 At the same time, the extremely complex and fast moving pace of developments in the communications sector as a whole, requires that we guard against premature conclusions about the nature and extent of the 'net neutrality' problem. Ofcom recognises the need for caution, particularly when contemplating very broad interventions such as a blanket ban on any form of traffic discrimination, or the immediate introduction of a guaranteed quality of service for the internet.

Section 4

Traffic management and discrimination

Introduction

- 4.1 We note in Section 2 that one substantial concern expressed about traffic management is that it may lead to anti-competitive discrimination.
- 4.2 In this section we look at the role and the potential competitive impact of traffic management and outline how we might consider issues that might arise. We set out our initial thoughts but we are aware that these are a new set of issues and any views can only be preliminary at this stage. Our focus is on understanding the implications of traffic managements for consumers.
- 4.3 The section discusses:
- the traffic management debate within the industry as it relates to these issues;
 - potential risks for consumers associated with banning traffic management; and
 - potential risks for consumers of different types of 'traffic management'.

The debate within the industry

- 4.4 Views on traffic management have been polarised. Although there are exceptions, in general content providers have opposed traffic management by network operators and ISPs, while network operators and ISPs have claimed that they should be allowed to engage in most types of traffic management.
- 4.5 Here we attempt to set out the broad terms of the debate without referring to the position of individual stakeholders. We believe this would be premature, as some stakeholders may not have yet reached firm views and may want to make their views known as a result of this discussion document.
- 4.6 Content providers who oppose traffic management have voiced concerns that if ISPs were allowed to freely engage in traffic management they could overcharge and/or discriminate in favour of their applications or content. This, it is sometimes argued, may hinder investment "at the edge of the network" where, it is further argued, most value to consumers is generated.
- 4.7 Those who have expressed this concern often suggest the need for *ex ante* regulation²⁰ to restrict traffic management. Below are two possible options to deliver this:

²⁰ *Ex ante* rules – for example, a ban on the setting of wholesale charges for quality of service – involve the setting of restrictions on firms' conduct in advance. They are particularly appropriate where the market power of the firms in question is both clearly demonstrated and enduring in character. The alternative is to intervene on a case-by-case (*ex post*) basis, for instance by considering specific complaints under competition law or dispute resolution mechanisms under sector-specific legislation. This may be more appropriate where it is not clear whether firms have market power or not (for instance, because markets are fast-moving), and where the conduct in

- i) If there was concern around (over) charging by ISPs, one potential option is simply to prevent charging – i.e. imposing a 'zero price cap'²¹.
 - ii) Alternatively, if the principal concern was discrimination in favour of the ISPs' own content, applications or services, then a regulatory remedy could be a prohibition on discrimination.
- 4.8 Network operators and ISPs, on the other hand, have generally argued in favour of freedom to engage in traffic management. They have claimed that content providers expect a free ride on their network investment and that, in the absence of traffic management, their subscribers would be worse off as they would suffer from the effects of traffic congestion. Furthermore, some have argued that by banning traffic management consumers and content providers who are willing to pay for a higher quality of access could not have their demands met. Therefore, they have argued against any form of *ex ante* remedy.
- 4.9 In order to discuss these issues we believe it is worth asking if there are benefits from traffic management and exploring in which cases concerns may emerge.

Potential concerns associated with banning traffic management

- 4.10 Traffic management can play two main positive functions. First, it can prevent congestion²² which leads to all users suffering harm. Second, it allows the prioritisation of services which are valued more by consumers if delivered in a timely fashion – i.e. enabling or increasing the quality of delay-sensitive applications such as online game applications, telemedicine, or to a lesser extent video and VoIP. Network operators and ISPs could set differential charges for such prioritised services.²³
- 4.11 Absent traffic management, there is a risk that congestion may slow down traffic and reduce the quality of service experienced by all consumers. Congestion means that ISPs would either have to invest in further capacity or, if that was not appropriate or efficient, ration consumers demand and only allow traffic generated by the services most valued by consumers to avoid delay. If ISPs could not respond to congestion by rationing demand it is likely that there would be negative impacts for consumers, at least in the short term. At best, delay-sensitive services would be adversely affected. At worst, all traffic and services could be affected at times. This could also reduce incentives to invest in delay-sensitive content and applications.
- 4.12 Consumers do not all have the same tastes and preferences. Some may be willing to pay to minimise the risk of receiving a low quality service, for instance keen internet gamers. If traffic management was not possible at all, ISPs could not meet the demand of these quality-sensitive consumers. This could mean that some consumers may not be able to receive the internet access service they want (even if they were

question could involve both benefits and risks for consumers depending on the circumstances and so needs to be evaluated on their merits.

²¹ We do not consider in this document whether these are remedial options that we could impose under the current regulatory framework.

²² Congestion arises when the traffic generated by consumers accessing the internet is larger than the maximum traffic the network can deliver. As a result not all traffic at that point in time would be able to be delivered in a timely fashion. Some or all content may therefore suffer from delays.

²³ ISPs could prioritise traffic without having to charge. However, in order to be economically efficient traffic management practices should give priority to those services and applications that are most valued by providers and ultimately consumers. Pricing is the instrument to achieve that by excluding or delaying services that provide less value to consumers.

willing to pay for it²⁴). This applies not only to existing services but also to any delay-sensitive service yet to be developed.

What are the potential concerns associated with traffic management?

- 4.13 The previous paragraphs highlight potential benefits of traffic management and the implications for consumers. However, traffic management practices also have risks, these include:
- i) ISPs could engage in exclusionary behaviour by, for example, targeting rival content and application providers and discriminating against them.
 - ii) There could be concerns in relation to pricing, investment and innovation.
- 4.14 Both can lead to consumer harm.
- 4.15 Our initial view is that an ISP which undertakes traffic management must have some degree of *market power*, which here we qualified as “substantial”,²⁵ in order for regulatory concerns to be triggered (though there may be other conditions which have to be met as well). Generally in order to assess the level of market power we would need to define the relevant markets in which such market power arises. Given the early stage of the debate and the absence of complaints or concrete examples of discrimination presented to Ofcom to date, we don't believe it is useful to attempt to specify exactly the relevant product and geographic markets where this market power may arise.

Discrimination against rival content, applications and service providers

- 4.16 One of the major concerns in the debate has been the ability of ISPs to engage in exclusionary practices, such as blocking access, price discriminating against, or degrading the quality of access provided to rival content and applications providers. This could take two forms:
- ISPs could *defend* the position of their existing content and application services from competition from new entrants; or
 - ISPs could attempt to *leverage* a position of market power in retail internet access into the relevant markets for content and applications.
- 4.17 While these are well-known types of exclusionary conduct, it is worth bearing in mind that consumer detriment from exclusionary behaviour only arises when certain cumulative conditions are met.
- 4.18 First, ISPs should have (a “substantial” degree of) market power. Without market power there is a strong presumption that no anti-competitive effects and consumer harm will arise. This is because consumers will tend to punish attempts at exclusionary behaviour by simply shifting their business to an alternative provider who does not engage in the same exclusionary practices. At present, both the fixed

²⁴ An example of this could also be the ability of the internet to operate as broadcasting platform. Absent a guaranteed quality of services, it seems that it could be difficult for the internet to play that role and be able to compete with other broadcasting delivery services.

²⁵ Market power needs to be substantial in order for exclusionary behaviour to lead to consumer harm. We have not used any of the legal thresholds— i.e. dominance under the *98 Competition Act* and Significant Market Power (SMP) under the *03 Communications Act*— because the discussion is at a broad conceptual level in this document.

and wireless retail broadband markets in the UK are considered effectively competitive. In principle, therefore, there ought to be sufficient choice of provider to discipline firms' behaviour. This assumes that consumers are able to make informed choices between providers which include considering the effects of discriminatory traffic management policies.

- 4.19 Second, for a discriminatory strategy to be plausible, an ISP would either be vertically integrated into some content, applications or services markets or planning to do so in the future. In the UK, some ISPs provide some content, applications and services in addition to internet connectivity. The most prominent examples are those are of TV services— e.g. Tiscali TV or Sky – or video-on-demand – e.g. BT Vision. One existing and controversial example of such a concern relates to VoIP services which have been prohibited on some mobile and fixed networks in Europe because they are seen to compete directly with the network operator/ISPs' own voice telephony services²⁶. However, as discussed above, concerns about consumer detriment would arise only if the ISP engaging in such practice had market power but we do not currently consider that this is the case in the UK.
- 4.20 Even if the above conditions are met, ISPs may not always have an incentive to exclude competitors. For example, content and applications providers may make limited or no margin or ISPs may not have the technical or commercial expertise to develop or launch content and application services in competition with third party providers.
- 4.21 We are well aware that in order for competition between ISPs to be sufficient to remove or reduce incentives for any ISP to behave anti-competitively, consumers must be able to make well informed decisions and need to be able to change provider without incurring unnecessary switching costs. In Section 5 we look at concerns that consumers may have insufficient information or may not be able to correctly process the existing information. Separately, we will be consulting on how to make the processes for consumer switching easier. We believe that these efforts to ensure that competition between ISPs is vibrant are the most effective way to minimise the risk of anti-competitive behaviour.

'Two sided-markets' and charging for access to consumers

- 4.22 In addition to concerns about exclusionary or discriminatory behaviour, some net neutrality proponents have argued that network operators and ISPs should be banned from charging content providers to prevent them 'overcharging' content providers for access to consumers.

Two-Sided Markets

- 4.23 In order to understand this potential concern it is necessary to explain the concept of a 'two sided market'. Two sided markets can be described as markets where platforms provide services to two, or more, distinct groups of 'consumers'. The key aspect though is that the benefits or value that these groups of consumers derive

²⁶ We do not believe this to be a concern in the UK where there is competition between four independent mobile networks and indeed one mobile operator has already allowed access for free to VoIP providers and others have also allowed access if consumers subscribed to the larger bundle contracts.

from using the service also depends on the participation (or usage) of the other group.²⁷

- 4.24 Internet access is an example of a two-sided market. The two sides consist of consumers purchasing internet connectivity on the one hand, and content, applications and service providers on the other. ISPs allow consumers to access content, applications and services, and the latter to access consumers. In theory, this should be a mutually beneficial arrangement. Satisfying the demand of each side depends in part on the participation of the other. For example, consumers would value internet connectivity more highly the more content and applications they can access. Similarly the value content providers find in offering online services increases with consumer internet take-up as it offers them a chance to reach larger numbers of consumers.
- 4.25 The main regulatory implication is that when a platform sets the prices on each side it should in theory take into account these linkages to get the right (most profitable) balance between participation on both sides. For example, charging too much to consumers, will lead to reduced take-up of broadband internet. The internet then becomes less attractive to content and application providers. Conversely, if network operators and ISPs overcharged content and applications providers for access to consumers, that would lead to reduced investment in content and applications, which would in turn make the internet less attractive to consumers. In theory, the ISP is well-placed to act as an 'honest broker' bringing two sets of preferences together.
- 4.26 The need to take these linkages into account does not mean that both sides should pay equivalent amounts of the costs of distribution. For example, newspapers show a wide variety of business models. Some newspapers are distributed for free to readers and the entire cost is covered by advertisers. Others, such as the main national newspapers, charge readers for a paper copy, but also rely on advertising revenues. More specialised publications – e.g. some journals and magazines – have limited or no advertising and are almost entirely financed by the readers' subscription fees. Newspapers are in the best position to decide which model best suits them and their readers and different markets co-exist even within the same market segments.
- 4.27 The example of newspapers highlights that in some cases, business models need to factor in the presence and relative strength of demand linkages between the two sides of a two-sided market.²⁸ Indeed, ensuring that these demand linkages are properly taken into account is critical to achieve the desired 'efficient' market outcome.
- 4.28 Prohibiting charging on one side of the market – i.e. to content and application providers – would be appropriate only if there was evidence that consumers place value on additional services, applications and content significantly more than the service providers value access to consumers.
- 4.29 On the basis of our preliminary analysis, it is not clear that such a prohibition would be proportionate. Indeed the introduction of wholesale charging could be consistent with an efficient market outcome.

²⁷ These effects are technically known as "cross-group externalities".

²⁸ Rochet, J.C. and Tirole, J., "Two-Sided Markets: A Progress Report", *RAND Journal of Economics*, 2006, 37, 645-667

A Competitive Bottleneck?

- 4.30 More specifically concerns could arise if the platform (in this case the network operator or ISP) is a “competitive bottleneck”. This can lead to a potential market failure and has been used as a theoretical framework to examine the need to regulate the level of termination charges for voice telephony.²⁹
- 4.31 In order to understand when a “competitive bottleneck” situation could arise we refer to the concept of single and multi-homing. When consumers on one side of the market subscribe or use one provider they are said to “single-home”, when they use more than one platform they are said to “multi-home”.
- 4.32 The “competitive bottleneck” refers to a situation when consumers on one side multi-home and on the other side single-home. In this situation, each platform has market power in providing access to its own single-homing customers. This arises because each platform controls access to each of its own members or subscribers and the parties on the other side of the two-sided market have no choice than to deal with that platform, if they want to reach their subscribers. The term “competitive” in “competitive bottleneck” refers to the fact that this market power exists irrespective of the number of competing platforms. Market failure manifests as a distorted price structure³⁰ which cannot be corrected by increasing the degree of competition between platforms. As a result one side – the multi-homing one – is charged “too much”.
- 4.33 We note that network operators and ISPs, although not currently subject to any regulatory restrictions on charging content and applications providers, do not currently appear to do so. Therefore, the potential risk of overcharging is currently only hypothetical. Nonetheless, it is worth asking the question of whether internet access may be a “competitive bottleneck” market of this kind. This might be the case if consumers generally subscribe to only one ISP (i.e. they single-home) while content providers wish to be available to subscribers to all ISPs (i.e. they multi-home). This would suggest that each ISP may in principle have market power in providing content providers with access to their single-homing customers. Therefore, it is appropriate to assess whether there is a risk that ISPs, having the freedom to charge content and application providers, may charge “too much” as explained under the “competitive bottleneck” case.
- 4.34 It is worth noting that there may be some important countervailing considerations. First, content and application providers may reverse any “competitive bottleneck” outcome by committing to exclusive contracts. Providers of content highly valued by consumers may agree to provide it exclusively to one network operator or ISP in return for some “compensation”, rather than having to pay “too much” to the network operators/ ISPs for access. In this case it may be network operators/ISPs who “pay” content and application providers for their content rather than the other way around.

²⁹ Armstrong, M., “Competition in two-sided markets, *RAND Journal of Economics*, 37(3), Autumn 2006, 668–691.

³⁰ This is often referred to as the waterbed effect. This describes the situation where extra profits made on the multi-homing side are competed away to attract single-homing consumers on the other side. The waterbed effect could be either full i.e. any profit generated from content providers will be competed away in the consumers’ side, or incomplete i.e. only some of the profits will be competed away.

- 4.35 Second, content and application providers particularly valued by consumers (e.g. Google, Yahoo, Amazon, YouTube etc.)³¹ could exert bargaining power over the network operators/ISPs. A network operator/ISP unable to offer any of the content and applications consumers want seems likely to be at a significant competitive disadvantage. It seems possible, though we understand is not happening now, that in this case network operators/ISPs may have to pay in order to offer content and applications valued by consumers.
- 4.36 This outcome is particularly likely if the degree of competition between network operators/ISPs is high and consumers are able to switch easily between them. In this case network operators/ISPs may seek to retain key content so as to attract and/or retain consumers. Switching, therefore, has an important role to play and, as mentioned above, we are currently undertaking work to ensure that the processes for switching ISPs do not impose unnecessary barriers for consumers.
- 4.37 Third, the assumption that consumers single-home does not reflect the fact that consumers often have access to the internet from home and work. They may also have access to the internet via both a fixed and a mobile line. In practical terms this would mean that the network operator/ISP "bottleneck" market power towards a content or application provider would be lessened as blocking or charging them too much would not impact on their ability to reach consumers via another network operator/ISP. Hence, if, at least, a proportion of consumers in fact multi-homed it could be argued that the market power that ISPs may have under the "competitive bottleneck" situation would be reduced. This is clearly difficult to establish other than empirically.
- 4.38 All these factors may limit the ability of each network operator/ISP to benefit from their potential "bottleneck monopoly" position in relation to access to their own single-homing customers by charging "too much" to content and application providers.

Concluding remarks on two-sided markets

- 4.39 Ofcom's initial view is that a prohibition on network operators/ISPs charging content and applications providers for access to consumers is unlikely to lead to efficient market outcomes. In simple terms, it means that consumers have to bear all of the costs in a 'two sided market' in which content and applications providers clearly benefit from access to consumers as well as vice versa.
- 4.40 Equally though, we would be concerned if the kind of pricing structures implied by the theoretical model of the simple³² "competitive bottleneck" situation started to emerge. In practice, in order to conclude whether such prices are likely to be "too high" one would need further evidence. Currently with the information available Ofcom does not consider that there is a need for controlling future prices by network operators/ISPs and in particular setting them at zero seems difficult to justify, even if Ofcom had the power to impose such a pricing regime. At this stage, there is little concrete evidence to hand as to what kind of pricing models will be proposed either by network operators/ISPs for access, or by content and applications providers for their products. We would be interested to hear stakeholder views and any further evidence they

³¹ Even small or niche content providers may have some bargaining power if some users particularly value their content.

³² For example, in a hypothetical world where consumers single-home and content and application providers did not have bargaining power vis-à-vis the ISPs.

might wish to present. If concerns emerged we may consider it appropriate to review our conclusions in the future.

Investment Incentives

- 4.41 So far, most of the discussion has focused on what might be termed 'static' arguments relating to the short-term effects of the introduction of traffic management. However, we are aware that a substantial part of the debate on traffic management or 'net neutrality' has focused on the investment incentives of the stakeholders involved – i.e. it relates to a 'dynamic' analysis of how the market could change over the long-term.
- 4.42 In particular, content and service providers have claimed that if network operators and ISPs started charging them this may have serious effects on their incentives to invest and innovate with wide ranging consequences for the internet at large.
- 4.43 Conversely, some ISPs and network operators have put forward the argument that in the current situation, content providers are "free riding" on their network investment and so there is a disincentive on the ISPs to invest in their networks.
- 4.44 Above we concluded that it is possible to envisage a scenario where ISPs charge for content delivery, and that it was not clear whether these prices could be considered inefficient – i.e. "too high" from a static point of view. However, it may be argued that if prices were "too high" this may lead to fewer funds for content providers to invest and innovate – i.e. it may have dynamic efficiency implications.
- 4.45 This argument raises two issues. First, if zero pricing is not efficient we could end up with "inefficient" investment in the provision of content and applications.³³ Second, it is difficult to predict what the outcome without pricing restrictions could be. This is partly because it is unclear what network operators and ISPs' incentives are in relation to setting charges.
- 4.46 As discussed above, assuming that they are not constrained by any of the countervailing factors outlined, one possible outcome is that network operators and ISPs prioritise short term profit maximisation and aim to set prices which are "too high".
- 4.47 However if network operators/ISPs take a longer term perspective, there would appear to be little incentive to exclude content and application providers, especially those which do not compete with their own services. Indeed, it seems that ISPs which are able to offer more content and applications would be preferred by consumers.
- 4.48 A variant argument we have heard is that it is possible that a two-tier system may emerge with the current "best-effort" access provided for free and priority access available for a fee. Content and application providers could, therefore, opt for priority access if their consumers valued the extra quality that it could provide, and the revenues could in turn translate into better services for consumers. Some services – i.e. those that are particularly sensitive to delays – may never take-off in the absence

³³ If access is priced at zero, this may be below the opportunity cost and lead to "too much" investment in content and application and "too little" in access or connectivity. This would result in an internet world where there is too much content because content and application providers are not charged, but too few consumers connected to the internet, because all the costs to provide connectivity are recovered from consumers.

of priority access and their incentives to invest and innovate could be negatively affected by the absence of priority access. Such a two-tier system may also allow new services first to emerge in the best effort tier and then migrate into the higher quality and pay-for tier if they prove to be particularly valued by consumers.

- 4.49 An open question raised by such a development would be whether such a change would put smaller or niche providers at a disadvantage encouraging consolidation in the content and applications markets to the longer-term detriment of the internet economy. These distributional impacts are difficult to assess; on the one hand, we know that the internet economy is already exhibiting strong rewards for economies of scale. On the other hand, it may be that introducing the scope for charging actually benefits niche services which are highly valued by a small number of consumers.
- 4.50 It is possible to postulate a future scenario in which the introduction of traffic management and the kind of charging models described in this chapter lead to a different kind of internet economy, in which the space available for the 'best efforts' internet – and the low barriers to market entry and innovation that it guarantees – is reduced. If this outcome starts to emerge, it is likely that this would lead to pressure to regulate to avert this. One possibility would be to use the powers to impose minimum quality of service to define a 'best efforts' internet to which all network operators and ISPs would have to designate a certain proportion of network capacity. However, we re-emphasise that there is as yet no evidence that this problem is arising, and good reasons to doubt that it will arise, given the current competitive market structure and the incentives on network operators and ISPs existing within that market structure.

Investment in new network capacity

- 4.51 It is worth also considering the impact of policies in this area on the investment incentives of network operators and ISPs. Two arguments have been advanced here which lead to diametrically opposite conclusions. The first argument is that network operators and ISPs face the correct incentives to invest in next generation networks only if they have freedom to introduce traffic management policies and, by implication, address the 'free riding' problem of new network capacity being exploited by content and applications providers without any monetary compensation. The second argument is that allowing traffic management practices to be deployed will actually disincentivise investment in new network capacity – allowing the network operators and ISPs to continue to restrict supply. This argument would require all ISPs to coordinate their actions.
- 4.52 In the two-sided market framework put forward above we concluded that it is likely to be efficient for costs to be recovered from both sides of the market, although there may be a risk that "too much" may be then recovered from the content and application side. However, in the long term it may be important to consider the appropriate response in terms of capacity investment. In our view, the pressures on network operators and ISPs to invest in new capacity will exist whether or not traffic management is permitted, because in a competitive market, consumers will gravitate towards platforms which provide access to the greatest number of services at the highest speeds and with the fewest feasible restrictions on usage. But one feature of the expansion of network capacity is that can often only be increased by investing in large increments – perhaps far more than are required in the short term - so that part of that capacity could remain underutilised for some time. Permitting traffic management would allow network operators and ISPs to address short-term capacity

problems, whilst making longer-term capacity investment at the time when it is most efficient to do so.

Summary

- 4.53 In this section, we have put forward an approach for assessing some of the arguments about the potential benefits and risks of traffic management. Our emerging views for discussion are set out below.
- 4.54 **We do not currently see a strong rationale for preventing *ex ante* all forms of traffic management.** However, some forms of discrimination could raise consumer concerns in some circumstances. Discriminatory practices by firms with substantial market power are likely to come under particularly close scrutiny.
- 4.55 **Charging both consumers and content providers for guaranteed quality of service might potentially benefit consumers.** We recognise that the longer term distributional/structural impact of such a development – in particular on the range and diversity of providers of content, applications and services – would need to be carefully monitored, given the potential risk that 'overpayment' problems could arise and innovation could be harmed.
- 4.56 **If appropriate Ofcom will monitor developments in the sector.** Maintaining a watching brief in the sector would enable us to be alert to potential difficulties arising in the market.
- 4.57 The Revised Framework provides for governments to give NRAs the power to impose a minimum quality of service on communications providers. In that event there are a number of approaches we could take but it is likely that our initial view would be to explore existing competition tools and consumer transparency options before considering a minimum quality of service.
- 4.58 In summary, the question of whether any form of discrimination between providers is desirable is a complex one. Our initial analysis indicates that there is currently no strong case for an outright *ex ante* prohibition on all such discrimination. Regulatory intervention which focused exclusively on traffic management (prohibiting certain forms of traffic management) could have the unintended consequence of encouraging the development of closed networks and devices which evade any such ban. However, the concerns highlighted in this section arose we would examine such instances on a case-by-case basis applying our full range of *ex post* powers as appropriate. If in the future evidence of more persistent and recurrent behaviour that could lead to consumer detriment emerged we could consider whether it would be appropriate to use our *ex ante* powers.
- 4.59 Where market forces fail to provide sufficient transparency there may be a case for regulatory intervention in this area. This is discussed in the following section.

Section 5

Consumer information and transparency

Introduction

5.1 Traffic management presents a potential challenge for consumers who may find it difficult to identify when traffic management practices are being used and, even when they are informed may find it difficult to understand what impact these practices might have on their service. There are two key issues for consumers:

- Firstly, when comparing different services consumers might find it difficult to understand the various traffic management policies and the impact that these policies would have on their user experience (e.g. on the content, services and applications they may want to access).
- Secondly, consumers might find it hard to understand the impact that any *changes* to their existing provider's traffic management policy would have on their user experience.

5.2 We believe that a lack of transparency around traffic management may already be emerging as an issue for consumers.

5.3 This section considers whether improvements need to be made both to the quality and the manner in which information about internet traffic management practices is provided to fixed and mobile broadband consumers.

5.4 We start with a reminder of why consumer transparency is so important to the traffic management debate, and summarise the current situation in the UK. We then consider three key issues:

- First, what could be done to improve consumer transparency around traffic management practices, and in particular *what type of information* is more relevant to consumers?
- Second, *how can this information be presented* so that it is accessible and meaningful to consumers? We provide some examples to elicit discussion.
- Finally we consider how consumers are likely to use information provided and reflect on whether there are useful insights from behavioural economics that we could build on.

There is wide agreement on the importance of consumer transparency

5.5 One aspect of the traffic management debate in which there would appear to be wide industry agreement is the importance of informing consumers of the existence and extent of any traffic management practices, and of any restrictions to their access and use of content, applications and services.

5.6 This is reflected in the Revised Framework, which envisages that providers may be required to publish transparent, comparable, adequate and up to date standard terms

and conditions. More recently, the European Commissioner, Neelie Kroes, stated at a conference in Paris on 13 April 2010³⁴ that transparency is “non-negotiable” and that it should be crystal clear to consumers what the network operators and ISPs practices mean for them.

- 5.7 Ofcom strongly shares this view. We believe that, in any future commercial scenario, it is critical that consumers should have access to meaningful information on policies that affect their experience including relevant traffic prioritisation, degradation or blocking policies being applied by their ISP and that they are able to factor this in when making purchasing and/or switching decisions. To do so it is important that the information supplied is comparable.
- 5.8 In the previous section, we noted that effective retail competition appears to reduce the scope for traffic management to be used anti-competitively. But for that competition to be effective in constraining firms' behaviour in relation to traffic management consumers need to be able to judge whether their current ISP or network operator is providing a form of traffic management that reflects their particular needs, and if necessary act on this information to switch provider. But clarity of information about traffic management is also an important consumer right in itself. Consumers are often willing to sign 12-24 month contracts for fixed and/or mobile broadband in order to benefit from lower prices and/or free hardware e.g. a modem/router/latest “smart phone”. This is especially the case for mobile broadband. The increasing prevalence of longer term contracts and early termination charges, mean it is important that consumers make the right choice of provider and package when they first sign up, which in turn suggests that clarity about traffic management policies at point of sale is vitally important. In addition, consumers could face additional charges for exceeding their usage caps. We explore some of these difficulties later in this chapter.

Effectively providing consumer information is a challenge

- 5.9 Informing consumers of the existence and impact of internet traffic management practices in an effective manner is not straightforward. These practices can be difficult to understand and even to detect. For example, it can be difficult to determine whether a degradation in the quality of a broadband service is attributable to:
- the use of a traffic management technique by a network operator or ISP such as 'bandwidth throttling';
 - the selective blocking or delay of IP packets linked to a particular service;
 - the preferential allocation of a households broadband connection speed to specific services; and/or
 - some other unrelated factor such as congestion in the core internet or too many users trying to access the same service from a limited capacity internet server.
- 5.10 We recognise that it can be challenging to design approaches that ensure that consumers are informed but don't create an undue burden on industry. Simply providing large amounts of information has its own drawbacks as it can be ineffective at best or even increase consumer confusion.

³⁴ <http://europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/10/153>

- 5.11 Therefore it is important that the information provided to consumers is not only relevant but also provided by the most effective means. Ofcom has taken a number of different approaches to the provision of consumer information with respect to other aspects of telecommunications services. For example, we have proposed consumer information remedies about consumer complaints handling and right to alternative dispute resolution (ADR) services which would require the provision of information by letter and on websites.³⁵
- 5.12 Our previous work has highlighted that the most useful and effective way to provide information needs to be considered on a case by case basis. We also think it is important that any informational approaches relating to traffic management are considered in the context of other information disclosure obligations that network operators and ISPs may have, to ensure consistency and to make sure that consumers are not overwhelmed by information.
- 5.13 The challenges of imposing effective informational approaches are not unique to Ofcom. We can also look to innovative solutions in other sectors. Some examples are:
- The introduction of smart metering for gas and electricity by Ofgem uses new technology to allow consumers to track and respond to their energy consumption levels.³⁶
 - The Financial Services Authority (FSA) has recently introduced new rules about the way banks and building societies do business with their customers for deposit-taking and payments. This includes provisions for “greater transparency” and a requirement that for savings accounts, some of this information may be set out in a summary box that helps consumers compare different accounts from different providers.³⁷

Consumers are increasingly aware of restrictions

- 5.14 Consumers are becoming increasingly conscious of restrictions in their use of broadband services. (E.g. about caps on the amount of data which they can download in a given period.)
- 5.15 However, at this stage of market development, consumers show greatest interest in, and awareness of headline speeds. Indeed, as consumers make more use of the internet for bandwidth heavy activities connection speeds is becoming a key factor in determining choice of broadband provider.
- 5.16 The importance of broadband speed is also reflected in the complaints Ofcom has received from consumers. In the last two years Ofcom's Advisory team has logged 2,570 complaints relating to fixed and mobile broadband speeds. The majority of these complaints (1,275) were around fixed broadband speeds, which consumers stated were 'too slow all the time'. To date, mobile broadband has not had as many complaints as fixed broadband, but as more consumers begin to start using 'smart phones' this may change.

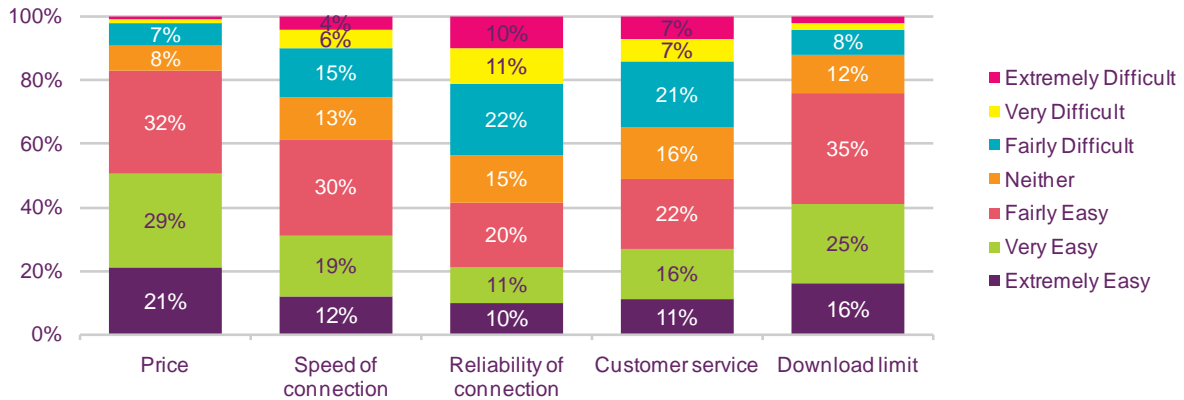
³⁵ http://www.ofcom.org.uk/consult/condocs/complaints_procedures/adr_condoc.pdf

³⁶ <http://www.ofgem.gov.uk/Media/FactSheets/Documents1/meteringfs.pdf>

³⁷ http://www.fsa.gov.uk/Pages/consumerinformation/product_news/banking/banking_conduct_regulation/index.shtml

5.17 Ofcom research undertaken as part of our work on the broadband speeds code³⁸ also found that the most common complaints to broadband service providers relate to slow connection speeds. Whereas web user experiences tend to be very positive for basic browsing, more bandwidth intensive web activity such as downloading or streaming generally results in lower levels of satisfaction. (In the vast majority of cases, 'speed' and/or 'connection reliability' were given as reasons for dissatisfaction.) Only a minority of UK consumers found comparing speed of connection (31%) and reliability of connection (21%) extremely or very easy to do.

Figure 5: Ease of comparing broadband features



Q16. How easy was it to compare the following Internet service features from different broadband suppliers?

Base: Those who have compared service features (1417)

Source: GfK broadband speeds survey among 2,128 online panel respondents who are broadband decision makers, September-October 2008

Some felt that the speeds received were not what they expected when they signed up to their broadband provider

5.18 In addition, 26% of the respondents stated that they didn't get the speeds they expected when they signed up and in rural areas this rose to almost one in three (32%).

5.19 However, it remains unclear whether this was due to being mis-sold the broadband service at the point-of-sale or whether the consumer did not accurately choose the service they required. For example, a high bandwidth user may have chosen a basic package due to the price but in turn this would be unable to meet their high usage requirements, speeds and therefore expectations.

Ofcom has already introduced information requirements through our Code of Practice on Broadband Speeds

5.20 Today, broadband consumers typically have access to information about price, connection speed and user allowance (the same information tends to be provided for the different offers).

³⁸ The UK broadband speeds consumer research report that Ofcom published in 2009 provided important insights into the current performance of the UK's broadband networks, and in particular the actual download speeds that consumers receive.

Information typically provided today

Price of package – what the monthly charge will be over the contract duration including any set up costs i.e. cost of a router/modem.

Connection speed – this generally covers only download speeds, but some operators also detail upload speeds. It is sometimes accompanied with a description about the expected functionality (e.g., BT Unlimited Option “Best for unlimited music and video downloads - and great for online gaming”; Sky’s unlimited package provides an upload speed of 1.3Mb to “share photos, videos and large files”). This information however is not always available in the first page.

Usage allowance – this is sometimes accompanied by a description of what it actually means in practice (Plusnet provides details on “what you can do with 10GB”, setting out that this includes “surf as much as you like; send and receive 6,000 emails; view 5 hours of iPlayer; download 500 songs”).

5.21 Within Ofcom’s Code of Practice on broadband speeds³⁹, there is also a requirement to provide information on policies on fair usage, traffic management and traffic shaping. In particular, ISPs are required to:

- publish on their website, in a clear and easily accessible form, information on the restrictions applied. This should include the types of applications, services and protocols that are affected and specific information on peak traffic periods;
- explain whether or not they provide the same QoS for all applications and services;
- publish, in a clear and easily accessible form, any criteria they use for determining breaches of its fair usage policy (e.g. total usage, specific percentage of users etc);
- publish, in clear and easily accessible form, the actions they intend to take should a user exceed a usage limit or breach a fair usage policy (e.g. the size of any extra charges or nature of any speed restrictions etc);
- provide a means by which users can measure their usage over the relevant billing period (where it is reasonably possible to do so; and
- provide users with email notification when users exceed a usage limit or breach a fair usage policy which informs users about the precise consequences of doing so, e.g. additional costs, information on speed restrictions imposed etc.

5.22 The broadband speeds work will now focus on strengthening the existing code in certain areas for example the issue of fair usage so that the code is more robust. We are planning to publish the new code after the summer.

But, on the whole, the information provided to consumers could be improved

5.23 Although the issue of traffic management policies is covered by the existing code, the level of detail varies, and the information is not always easily accessible. Last year, we conducted a mystery shopping exercise connected to broadband speeds and found that not all ISPs were fully compliant with the voluntary code⁴⁰. For example, only 13 of the 27 ISPs provided any information on traffic management, and only 4 of provided information on the time of worst congestion. In practice, therefore, there is a

³⁹ <http://www.ofcom.org.uk/telecoms/ioi/copbb/copbb/copbb.pdf>

⁴⁰ http://www.ofcom.org.uk/telecoms/ioi/copbb/voluntary_code_copbb/Synovate_report.pdf

mix of information provided by different players about the various applications and time restrictions that apply to services. The code also illustrates the inherent difficulties in verifying compliance with complex information requirements. It seems to us that at present, information about traffic management practices remains difficult to find and compare. Although there are a number of third party services that provide consumers with comparative information about the different broadband providers and levels of satisfaction (for example, USwitch⁴¹), it is worth noting that information about traffic management policies is not at present easily comparable via a third party "one stop shop".

- 5.24 Another potential problem is consumer confusion around technical terms. Ofcom research⁴² found that, for the most part, consumers do not fully understand the terms 'fair usage policy' and 'contention ratio'. Understanding was even lower amongst specific demographics (including older age groups and those with lower PC usage).
- 5.25 Even in those cases where the information is available and transparent, traffic management may not be detectable to the consumer at the point it takes place. More importantly, the impact of traffic management practices in the functionality of particular services may not be sufficiently clear for consumers.
- 5.26 There are effectively two different approaches when considering the information ISPs or network operators need to provide around their traffic management practices. Firstly, it could be very broad brush approach e.g. ISPs or network operators could provide very basic information putting the onus on consumers to seek out additional information via websites or customer services. Secondly, the approach could be more positive and inclusive e.g. ISPs/network providers could provide a larger amount of more detailed information up front via websites or other information sources.
- 5.27 Our initial discussions with stakeholders and consumer groups, including the Communications Consumer Panel, have highlighted that the challenge is not so much the provision of information per se, but the provision of relevant information, and the manner in which this information is provided and understood and acted on by consumers.
- 5.28 For example, even where detailed traffic shaping information is available to consumers they may not be able to use this information to determine the quality of experience they could reasonably expect when accessing different internet services, which would rely on them being able to:
- 5.28.1 Link technical information provided by a network operator or ISP such as connection speeds and 'contention ratios' to what this would mean in terms of 'quality of experience' for different services.
- 5.28.2 Confirm that any degradation in internet service quality is linked the use of traffic management by their network operator or ISP and not by congestion elsewhere in the internet distribution chain.
- 5.29 In view of this we believe that the information provided by network operators or ISPs should include some or all of the following:

⁴¹ <http://www.uswitch.com/broadband/customer-satisfaction/>

⁴² See figure 5.2 in

http://www.ofcom.org.uk/research/telecoms/reports/broadband_speeds/broadband_speeds/annex_6.pdf

- price of the package and what it includes i.e. connection speed rate and services you can receive at different times throughout the day;
- description of traffic management practices;
- if traffic management is used, why and how;
- how traffic management can affect a user's internet experience for different types of internet services;
- any changes made to their existing traffic shaping practices;
- information on usage caps and costs of exceeding that usage cap;
- options for upgrade; and
- number for technical support helpline.

International approaches to consumer transparency

- 5.30 Ofcom has been working with other European regulators through BEREC in the preparation of a report on the issue of 'net neutrality'. Most agree that consumer transparency is important but at present the majority of countries do not have specific transparency provisions relating to 'net neutrality'. In many cases there are requirements for network providers and ISPs to give detailed data about the services provided, including price, speed and fair usage conditions. However, in the absence of specific regulatory requirements the information network providers and ISPs provide voluntarily, varies and tends not to be extensive.
- 5.31 The approach taken internationally varies. In Slovenia the regulator issued a Recommendation on broadband speeds in December 2009, which requires that end-users be informed of any traffic management practices used by ISPs. There are also on-going initiatives in Denmark, France and Portugal to enhance transparency and standardise the information related to the broadband offers, whereas others like Spain are looking at the issue from a broader consumer rights perspective.
- 5.32 Some countries have addressed the issue more specifically. Norway for example promotes general principles of transparency but has not imposed any binding information disclosure obligations. Canada, by contrast, has imposed more prescriptive obligations (see box).

Canada

The Canadian Radio-Television and Telecommunications Commission (CRTC) has released a determination on internet traffic management⁴³. The determination is binding and action can be taken against ISPs who don't comply. This is untested until the CRTC receives a case or is asked to evaluate a wholesale tariff for a technical ITMP. The Canadians have started from a principles based approach, setting out four principles for its approach to net neutrality: (i) Transparency (ii) Innovation (iii) Clarity (iv) Competitive neutrality.

The CRTC considers that the disclosure of ITMP (Internet Traffic Management Practices) information is "vital" to consumers making informed decisions about their internet.

The determination requires that ISPs disclose:

- *Economic ITMPs*– this is pricing information for ITMPs – such as monthly bit cap limits, and charges that apply

⁴³ <http://www.crtc.gc.ca/eng/archive/2009/2009-657.htm>

for exceeding these limits. They also state that they consider that real-time usage monitoring tool is important so consumers can track their usage in relation to economic ITMPs.

It does not specify exactly how this information must be disclosed.

- *Technical ITMPs* – ISPs must provide information which “adequately informs” consumers about ITMPs and the impact on internet services.

The information has to be disclosed “clearly and prominently” on their webpage that describe the retail internet service offering (e.g. a link where speeds are described to information setting out how ITMPs may impact the service). It also has to be disclosed in marketing material, customer contracts and terms of service.

Information on their website must disclose at least the following information about technical ITMPs: (i) why ITMPs are being introduced; (ii) who is affected; (iii) when it will occur; (iv) what type of traffic is subject to management; and (v) how it will affect the internet experience, including the impact on speed.

This information has to be provided “clearly and prominently” on the ISPs website 30 days in advance of a new technical ITMP being implemented (30 days of notice by the primary ISP for secondary ISPs). “Housekeeping” or less restrictive technical ITMPs do not require advance notice.

The CRTC has also introduced privacy safeguards.

These obligations apply equally to secondary ISPs. (However the policy is currently not binding on mobile.)

Norway

In February 2009 the Norwegian Post and Telecommunications Authority published non-binding *Guidelines for Net Neutrality*.⁴⁴

The NPTA has taken a light touch approach opting for Guidelines that have been created in collaboration with industry. They will be updated as needed.

The Guidelines set out three principles for network neutrality, and the first of these is the principle of transparency requiring that internet users must be given information about:

- the capacity and quality of the internet connection; and
- if other services are provided to the user as well as the internet, how the use of other services will affect the internet access capacity.

The Guidelines do not specify how this information must be provided or further details about the exact nature of the information, leaving this to the individual providers.

Possible examples of approaches to consumer information and transparency

5.33 As mentioned previously there are different approaches to consumer transparency. Below we set out a few examples of the way that information around traffic management practices could be provided. These could be implemented in a number of ways for example via a voluntary code of practice, a co/self regulatory approach or a general condition. The examples are not meant to be exhaustive but have been included to instigate thoughts on which seem to be the most appropriate and what other considerations should be taken into account.

Example 1 – A tiered approach

5.34 A tiered approach on the ISPs website with the first tier of information clearly stating the basic information in an easy to read format and prominently displayed. The second tier could be an additional page with further technical information for

⁴⁴ <http://www.npt.no/ikbViewer/Content/109604/Guidelines%20for%20network%20neutrality.pdf>

experienced consumers who would like to know more about the service they could receive and implications that the traffic management practices could have on their usage.

Possible Benefits	Possible issues
<p>ISPs already publish basic information on broadband speeds, so this option does not seem burdensome.</p>	<p>Comparability is difficult as ISPs will display the information in different ways. Consumers will have to visit several different sites in order to compare services offered.</p>
<p>It caters for different information needs, reducing the risk of consumer overload.</p>	
<p>The first page on the site will contain basic information, the second page will contain additional information reducing the need for several click-throughs.</p>	

Example 2 – One stop shop

5.35 A central body (with expertise in the area) acts as an information intermediary. This body holds all the basic information on traffic management practices for each ISP (for example in the form of a website). In this case consumers would only need to go to one place to make purchasing decisions for their broadband.

Possible Benefits	Possible issues
<p>ISPs are likely to be more proactive in providing the information as would be incentivised to do so.</p>	<p>Consumers are unlikely to get an additional layer of detail that they might want about ISPs' traffic management practices.</p>
<p>The onus would be on the ISPs to ensure the information provided by them is accurate and displayed in an easy to read and understandable format.</p>	<p>The information provided by the ISPs will have to be cross checked against the service the ISP supplies to ensure they have provided accurate information which could be problematic. It might be difficult to cross check and therefore there will be a reliance on the ISP that they are providing the right information.</p>
<p>One stop shop for consumers looking to compare traffic management practices.</p>	<p>As it would be a central body who would have to compile the information and publish it on their site there could be issues about where the funding comes from.</p>

Example 3 – Price Comparison websites

5.36 Third party independent information intermediaries (such as price comparison websites who already deal in comparing services of different providers over a range of industries) could help consumers navigate their way through the different traffic management practices of each ISP. One option would be to extend the Ofcom

accreditation scheme (already in place for existing websites including Simplify Digital and Broadband Choices⁴⁵).

Benefits	Possible issues
Existing expertise and benefits of accreditation by Ofcom.	As the information required by the ISPs could be complex it may be difficult for an independent information intermediary to correctly interpret the information and display in an easy to read manner as it goes beyond simple price comparisons.
Majority of consumers are aware these websites exist for a range of services across different industries.	Consumers are unlikely to get the additional layer of detail that they might want about ISPs traffic management practices.

Example 4 – Real-time information

5.37 This example considers an option for delivering the type of information that could be useful for existing customers. Real-time information is given to consumers about the status of their network connection so that they are able to track their usage and ensure they are still within any usage limit set by their ISP. It also offers clarity on whether their connections speeds are slower due to congestion or due to traffic shaping.

Possible Benefits	Possible issues
<p>High levels of transparency.</p> <p>Easier for consumers to detect whether their services is being affected due to traffic management practices or network congestion.</p>	<p>Could be potentially expensive⁴⁶ for ISPs to implement as will require special software and/or hardware with only a few customers actually appreciating and using this functionality.</p>
<p>High level of consumer empowerment to deal with problems as they are potentially more informed consumers as the information displayed will be individually tailored to them.</p>	<p>There could be difficulties in supplying real time information accurately to each consumer. Relies on sufficient level of understanding and activity by consumers, which would not always be the case.</p> <p>There could be times when traffic is being managed elsewhere in the value chain which makes supplying accurate real time information more problematic.</p>
<p>Enables consumers the options to immediately upgrade or downgrade their service if they find the service doesn't match their needs.</p>	

⁴⁵ <http://www.ofcom.org.uk/consult/condocs/ocp/statement/pricescheme/consumerfaq/>

⁴⁶ We have not looked into the potential costs on ISPs for this approach but in relation to the other examples put forward this is likely to be the most expensive

5.38 We believe that the success of any approach could be evaluated by considering a range of criteria such as those set out in Figure 6 below. Our initial assessment of the above approaches against these criteria is purely indicative and we are interested in your views on whether these are the correct criteria and on our initial assessment.

Figure 6: Comparison of examples by key factors

	Tiered approach	One stop shop	Price comparison websites	Real-time information
Ease of understanding for consumers	●	●	●	●/●
Easily comparable for consumers	●	●	●	●
Ease of implementation	●	●	●	●
Easily measurable	●	●	●	●
How quickly changes can be incorporated/ updated	●	●	●	●
Possible cost	●	●	●	●

● High ● Medium ● Low

5.39 The illustrative approaches set out in this chapter are not exclusive. We recognise that there are a number of alternatives. For example, ISPs /network operators could market their consumer connection packages in terms of the Quality of Experience (QoE) they will deliver for different types of internet services such as video streaming, VoIP, web browsing, file downloading. If QoE was used, then the need to display traffic management practices may fall away as consumers will have a clearer idea of what their service will be able to provide and it will be easier to decipher whether their expectations are being met. However, there may be issues with the extent to which the QoE provided to consumers is a combination of factors both under the direct control of the ISP and other factors such as congestion in the internet core and the performance of in-home networks which are outside their control.

5.40 We welcome comments from stakeholders on these examples and suggestions of alternatives.

Behavioural economics may offer some insights into how to deliver information effectively

- 5.41 Behavioural economics uses insights from psychology to develop a better understanding of how individuals make decisions this can help us make better predictions about market outcomes, and how effective different approaches are likely to be. In general, firms have incentives to offer lower prices and better value products because this enables them to attract more consumers. However, this requires the following:
- 5.41.1 that consumers are able to effectively compare products/suppliers and identify which product is likely to best meet their needs; and
 - 5.41.2 that consumers are able and willing to switch when they identify a product that better meets their needs.
- 5.42 Some of the behavioural economics literature suggests that in some cases, these requirements may not be fulfilled. For example, even if consumers have access to transparent information on different suppliers' traffic management practices, they may not be able to effectively compare products. This could be because:
- 5.42.1 Information may be framed in a way that leads consumers to make potentially incorrect decisions, for example, consumers may be very sensitive to the way a product or offer is worded or presented.
 - 5.42.2 Combined with limited attention, this may mean that consumers ignore relevant information. Some studies suggest that consumers find it difficult to take into account many different product features when comparing products, even when information about different features is clearly displayed. It may be particularly difficult for consumers to take into account information about traffic management practices, particularly as it may be difficult for consumers to understand exactly how providers manage traffic and what effect this may have on their day-to-day experience of the service.
- 5.43 For example, the Federal Trade Commission (FTC) in the US commissioned a behavioural experiment to understand how consumers would react if they were given information on the commission received by mortgage brokers. The experiment yielded the interesting result that with additional information, consumers were less likely to choose the lowest cost product. Additional information in this case appeared to confuse consumers rather than improve consumers' decisions and this is borne out by similar research.
- 5.44 Where the effectiveness of a remedy depends on how consumers react, testing may play a useful role. Researching consumer reactions to a possible remedy may help to fine-tune the design and highlight any potential unintended consequences before the remedy is rolled out.
- 5.45 A number of research methods could be considered for this purpose. Experimental-style research methods may be particularly useful. Economic experiments require participants to make actual decisions or complete tasks, and can therefore allow actual consumer behaviour under different circumstances to be observed. Using experiments to road-test options may develop our understanding of how consumers would react to different proposals and offer insights into to fine-tune the design of any proposals to increase their effectiveness.

- 5.46 Therefore, we may consider undertaking a study to help in the selection and development of the most appropriate and effective approach.

Summary

- 5.47 Ofcom strongly believes that consumer transparency is critical in any scenario where traffic management occurs and that this should be the main focus of intervention in the short term.
- 5.48 We recognise that the use of traffic management techniques is, by its nature, difficult for consumers to detect and understand. It is therefore, critical that consumers are fully informed of any traffic prioritisation, degradation or blocking policies being applied by their network operator or ISP and that they are able to factor these in when making purchasing or switching decisions. This is important not just from the point of view of consumers' rights, but also relevant to the question of whether stricter rules may be required on discrimination.
- 5.49 However, we also recognise that it is unclear how far improved consumer transparency would alleviate all concerns about traffic management. Therefore, it would be important to review the efficacy of any approach. In the event that the potential for consumer harm remains, the Revised Framework does provide for alternative more prescriptive approaches such as the imposition of a minimum quality of service.

Section 6

Conclusions & next steps

- 6.1 This document is not a formal consultation. Instead it aims to set out our current thinking on traffic management and net neutrality and is designed to form part of a broader debate on these areas.
- 6.2 We think that there are two key issues:
- i) What stance should Ofcom take on discrimination?
 - ii) What is the best way to deliver consumer transparency?
- 6.3 In this chapter we summarise the analysis and initial conclusions drawn in this paper, set out what the next steps in the process are and explain how our work in this area relates to the wider debate taking place in the UK and Europe.

Discrimination: what stance should Ofcom take on discrimination?

- 6.4 At the current time we do not think there is compelling evidence of anti-competitive behaviour. Therefore, we do not think that there is a strong rationale for preventing *ex ante* all forms of traffic management. Indeed, given the potential for network congestion, some forms of traffic management are likely to lead to consumer benefits.
- 6.5 Our current analysis suggests that there are circumstances where traffic management could be used anti-competitively. As discussed in Section 4 our initial position is that discriminatory behaviour is only a potential issue where firms have substantial 'market power' and could discriminate in favour of their own services. In this case, any form of discrimination will come under very close scrutiny to ensure that there are no anti-competitive effects. We believe that there is insufficient evidence at present to justify the setting of blanket restrictions on all forms of traffic management.
- 6.6 The Revised Framework gives NRAs the power to impose a minimum Quality of Service on communications providers. Our initial view is that in that event there are a number of approaches we could take but it is likely that our initial view would be to explore existing competition tools and consumer transparency options before considering a minimum Quality of Service.

Transparency: what is the best way to deliver consumer transparency?

- 6.1 We recognise that lack of transparency could already be an issue for some consumers. It is critical that consumers are fully informed of any traffic prioritisation, degradation or blocking policies being applied by their network operator or ISP and that they are able to factor these in when making purchasing or switching decisions.
- 6.2 Stakeholders are already considering different approaches for delivering improved consumer transparency. But it is evident that merely providing additional information will not be enough to enable consumers to make informed purchasing and switching choices. Any approach would have to deliver information in a way that is meaningful for consumers, and is measurable and enforceable.

- 6.3 It is also unclear how far improved transparency would alleviate all concerns about traffic management and it would be important to review the efficacy of any approach.
- 6.4 For both of these questions it is important for Ofcom to be aware of developments in the sector to enable us to be alert to potential anti-competitive behaviour and consumer harm.

The wider debate

- 6.5 In addition to setting out Ofcom's work on net neutrality this document is intended to contribute to the wider net neutrality debate taking place at UK, EU and international levels. The national and international debate covers a broad range of topics. While some of these will relate to Ofcom's duties others are questions for legislators and governments.
- 6.6 We set out our role in Section 2 and the elements of the wider debate in Section 3. In particular we recognise that questions of 'fundamental rights' and the industrial policy preferences for the online sector are important but beyond the scope of this discussion paper and Ofcom's duties as a regulator.
- 6.7 There are many forums and groups who play an important part within the wider discussions. Below we highlight the key government interactions and consultations that have been scheduled to occur in 2010:
- Government intends to consult on the Revised Framework during 2010. This consultation could potentially include Ofcom's powers and duties in traffic management matters that arise under the Revised Framework. How Ofcom will ultimately take forward any power and duties which Government wishes us to implement will depend on the outcome of this consultation and Government's consideration of the wider issues.
 - The European Commission has stated its intention to publicly consult on net neutrality with an aim to report back to the European Parliament on whether any action is necessary by the end of 2010.
 - BEREC has set up a working group to consider net neutrality.
- 6.8 We will be engaging with the above where appropriate. In addition there are numerous other forums and groups who are contributing to the wider debate.

Next steps

- 6.9 This discussion document is not a formal consultation but is the start of two phases of work which will take place over the coming months. These phases are:

6.9.1 Phase 1 – Summer/Autumn 2010

- This discussion document is the first stage of a wider conversation around traffic management and 'net neutrality'. The document aims to elicit discussion and debate around the issues of discrimination and transparency.
- We are seeking views from a wide range of interested stakeholders.
- We will conduct a series of roundtables with industry and consumer and citizen groups.

- We are also seeking other opportunities to engage with stakeholders on the issues discussed in this document.

6.9.2 Phase 2 – Autumn 2010 - Spring 2011

- We propose undertaking a behavioural economics experiment to measure consumer behaviour in relation to traffic management, for example in regards to consumer transparency options and how they can best help consumers in making informed and empowered choices.
 - We will conduct further engagement with stakeholders and consumers.
 - Once Government has published its decision on implementation of the Revised Framework we will consider the impact of that implementation on our duties.
- 6.10 Depending on the outcomes of this work we will consider whether further consultation on detailed options is necessary.
- 6.11 Responses to this discussion document are required by the 9 September 2010. This will allow us to take responses into account when we input into the European Commission's Consultation. (We expect this consultation to conclude by the end of September 2010.)
- 6.12 Our questions for discussion can be found in Annex 5 and we welcome comments on the discussion questions and also other areas which stakeholders feel are important for us to consider.
- 6.13 We encourage industry and consumer groups to approach us, either through one of the events we are planning to undertake over the coming months or else by email on traffic.management@ofcom.org.uk.

Annex 1

The evolving structure of the internet

Introduction

A1.1 This annex provides an overview of the evolving structure of internet and its associated value chain. It highlights the points in internet distribution where traffic congestion is most likely to occur and so where the potential application of traffic management techniques may be used to address congestion.

The Internet value chain

A1.2 The internet value chain can be considered in 5 separate parts (see Figure 3):

- consumers;
- the network directly managed by the consumers ISP;
- the interconnections between different ISP which we will refer to as the *internet core* ;
- content distribution networks; and
- Online service providers.

Consumers

A1.3 Consumers have two key roles:

- as purchasers of internet connectivity from ISPs; and
- as consumers and/or providers of online content, applications and/or services.

A1.4 A range of consumer internet connectivity packages are available from ISPs. These typically offer different limits on the total amount that can be downloaded each month and limits on the maximum speed of the internet connection. For example, currently BT offers a basic broadband connection that has a 10Mb capacity cap and a maximum broadband connection speed limit of 20 Mb/s. BT also offers a premium package with an unlimited capacity cap and a maximum connection speed limit of 20 Mb/s.

A1.5 Internet connection packages with high download limits and maximum speeds are well suited to consumers wanting to access high quality video streaming services for significant periods and to be able to quickly download large content files and access web sites more quickly. More basic connection packages with lower capacity caps and speeds are more suited to standard web browsing, social networking and e-commerce applications.

A1.6 The range of online services for consumers has expanded rapidly with access to broadband. Whilst only simple web browsing applications were available a decade ago consumers are now able to watch live TV online, play interactive games with other internet users and conduct online video conferences calls.

- A1.7 Consumers are also providers of online content including video and photographs. This content can be shared by uploading it onto a third party social networking or content hosting site, or by purchasing a own web hosting service either from an ISP or a third party web hosting provider.

ISP network

- A1.8 An ISP provides the 'last mile' internet connection to their customers using either a fixed local access network or a wireless local access network. Fixed broadband access networks include those delivered over existing telephone wires using DSL technology and coaxial cable networks provided by cable TV operators. A characteristic of both these networks is that they provide a dedicated connection to each consumer's premises which means that the performance of this part of the internet distribution chain is not constrained by contention for internet capacity with other internet users. However, this part of the internet distribution chain is constrained by the maximum connection speed that can be supported on each individual access network connection. For DSL networks, limits on access network connection speeds become more pronounced the further a subscriber premises is from the local exchange. To overcome this more advanced fibre-to-the-curb and fibre-to-the-home Next Generation Access (NGA) networks are being deployed. A disadvantage of these approaches is that the additional infrastructure they require makes them more expensive to deploy than existing DSL networks.
- A1.9 On wireless access networks the spectrum allocated to each transmitter cell is shared by a number of different users and hence unlike fixed networks do not provide a dedicated connection for each subscriber. This means that the quality and speed of each user's internet connection is dependent on the other users' use of the network at the same time. A range of different approaches can be taken to improve the capacity and performance of wireless networks including the use of more efficient technical standards such as LTE, the use of smaller transmitter cells and offloading wireless network traffic onto fixed networks using Wi-Fi hot spot connections. Despite these measures the rapid growth in wireless internet traffic driven by Smartphone applications and wireless PC dongles makes it likely that that wireless access networks are likely to potentially face greater capacity and speed constraints than fixed access networks moving forwards.
- A1.10 The backhaul part of an ISP's network connects the local access networks to the internet core and is typically provided using fibre optic connections. The backhaul carries consolidated traffic from a large number of ISP subscribers and can during times of peak internet demand become congested. The level of backhaul congestion varies between different ISPs and is typically dependent on the timing of a particular ISP's investment in additional backhaul capacity to meet the increased internet capacity demands of its customers.

Internet core

- A1.11 The internet core comprises of a large number of interconnections between national and international ISPs. These are needed to enable customers with different ISPs to communicate and exchange data with one another and to access online services that are hosted by other ISPs. To reduce the cost of providing interconnections between their networks most ISPs enter into *peering* arrangements with other ISPs where traffic is passed between their networks on a cost neutral basis. In practice, smaller scale ISPs will typically pay larger ISPs some carriage fees to compensate for the asymmetry in traffic they are exchanging with the larger ISPs. There are a limited number of very large scale internet core providers, known as Tier 1

providers, including Sprint, AT&T and NTT who pay no fees to other ISPs for their peering arrangements.

- A1.12 As with the backhaul connection provided by ISPs, the interconnections in the internet core can become congested during periods of peak internet demand.

Content Distribution Networks

- A1.13 Many online service providers now use what is known as Content Distribution Network (CDN) to move their content closer to edge of the internet in order to prevent the quality of their services being impacted by traffic congestion in the internet core. These networks are best suited to non real time content services such as video-on-demand and web browsing. Using a CDN the content for these services is distributed and stored by the CDN operator on internet servers situated close to the consumer ISPs networks. When consumers request content from these services it is delivered from a local server operated by the CDN provider rather than a more remote internet server which would require the content to be delivered over the internet core. There are a number of third party CDN providers such as Akamai and EdgeCast but a recent trend has been for larger service providers including Google and Yahoo! to build their own CDNs for the delivery their content.
- A1.14 In practice most CDNs circumvent only the effects of congestion in the internet core and not in the ISPs backhaul or that in wireless access networks. Some ISPs provide their own CDN solutions to service providers wanting to avoid congestion in these parts of the internet delivery chain as well as the internet core. These CDN solutions are of particular interest to video-on-demand (VoD) service providers whose high capacity services are highly vulnerable to network congestion

Service providers

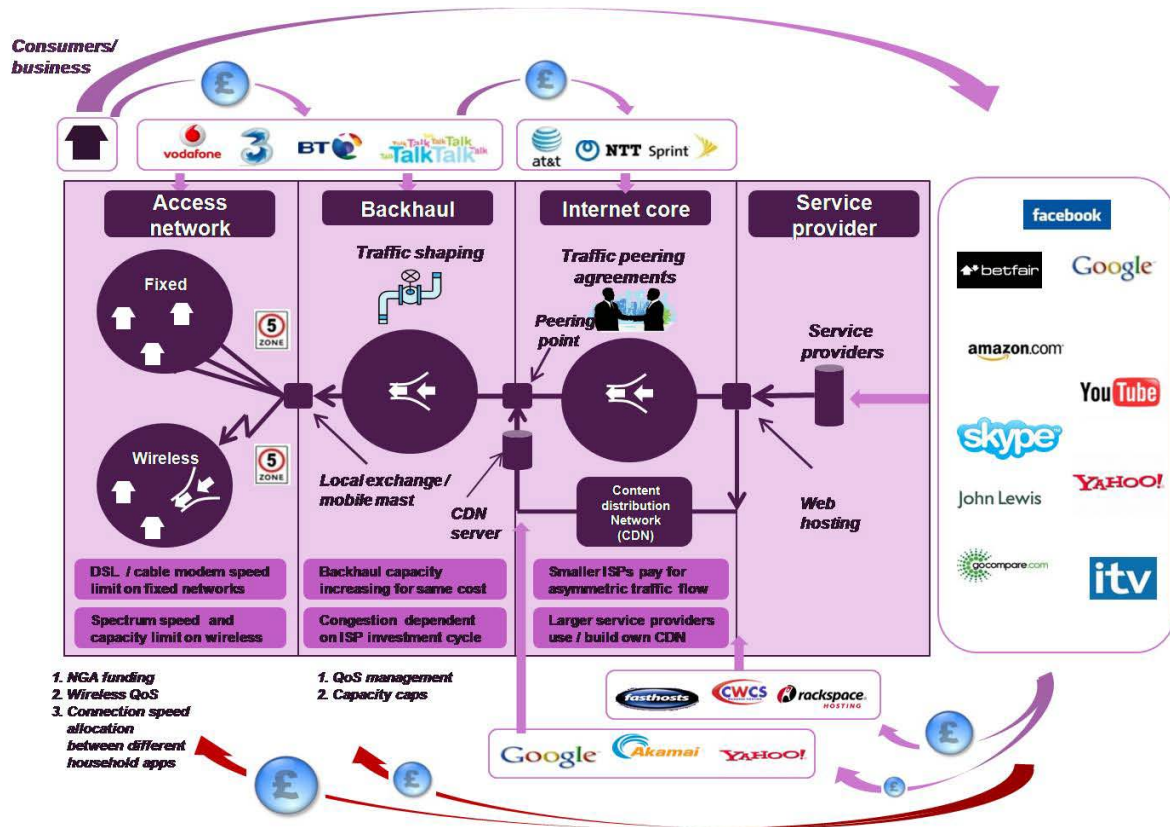
- A1.15 There is an expanding range of online service providers including those providing e-commerce, entertainment, social networking, search, and information retrieval services. In order to make their services available on the internet, service providers must take a web hosting service from either an ISP or a dedicated third party web hosting provider such as justhost.com and HostClear.com. These typically provide a service provider with an allotted amount of internet connection capacity, speed and server storage capacity. During periods of high service demand this part of the internet delivery chain can become congested reducing the ability to access the hosted services and their quality. The effects of this congestion can be reduced by the service provider by purchasing additional web hosting capacity.
- A1.16 As we set out above service providers may enter in distribution arrangements with CDN providers to reduce the impact of internet congestion on the distribution of their services over the internet core.

The evolving structure of the internet

- A1.17 The increasing adoption of CDNs and peering agreements between large service providers and ISPs is leading to an internet delivery structure whose performance is increasing dependent on the performance of the backhaul and local access networks provided by ISPs rather than the internet core itself. As a result there is an important debate over whether ISPs, who provide these parts of the internet delivery infrastructure, or service providers or some combination of both, should

fund future performance improvements in backhaul and faster next generation access fixed and mobile networks.

Figure 7



9

Traffic management is not a new feature of the internet economy

A1.18 As discussed in section 3.1 internet traffic congestion can occur two main parts of the internet distribution chain;

- the national and international inter-connections between internet service providers, known as the internet core; and
- the connections between the internet service provider and their customers.

A1.19 The Internet Protocol (IP) delivers services over the internet as a series of IP packets and deals with traffic congestion by first blocking the transmission of some IP packets and asking them to be resent and in cases of severe congestion dropping some IP packets completely. The impact of these IP packet delays and losses has a different level of impact on different types of internet services. The quality of service of real time services such as video streaming and VoIP is much more affected than non real time services such as web browsing and file downloading.

A1.20 Three forms of internet traffic management are already used to maintain the quality of some delivered services during periods of peak demand:

- traffic shaping;

- Content Distribution Networks; and
- ISP traffic prioritisation.

Traffic shaping

- A1.21 The latest generation of IP routers, used within the internet to direct IP packets between service providers and consumers, provide functionality that allows the router to determine the type of service each IP packet passing through it is being used to deliver for example: P2P, email, web browsing etc. This functionality allows ISPs to prioritise certain types of internet traffic over others during periods of peak demand by delaying or dropping completely some IP packets associated with some services. For example, ISPs can elect to de-prioritise the transfer of P2P packets used to download large content files or to limit the maximum speed video streaming packets can be delivered at during peak internet hours. This type of traffic management, often referred to as traffic shaping, makes it more likely that ISPs can maintain a reasonable level of quality of service for the majority of internet services used by a majority of users during periods of peak internet usage. It also provides ISPs with a greater degree of control over the need and timing of future investment in additional network capacity.
- A1.22 In addition, many ISPs impose 'fair usage' limits. This allows ISPs to elect to restrict total internet use for high usage customers by selectively applying traffic shaping to their internet connections during peak hours. Ofcom's Broadband Speeds Code of Practice requires that ISPs make it clear customers where traffic shaping and/or capacity caps are being applied by their ISP to their internet connection.

CDNs

- A1.23 Despite the increasing use of internet traffic shaping techniques there is no guarantee that services whose packets are not delayed or dropped as part of the traffic shaping process by ISPs will be delivered with an adequate quality of service during periods of peak internet demand. To achieve this, many content providers are electing to use either a third party CDN or to build their own dedicated CDN network rather than relying on the internet core to deliver their content. These consist of a fibre optic transmission network to deliver content to a number of strategically placed content servers distributed around the internet. CDNs provide an improved quality of service by enabling the service providers' content to be accessed from more efficient locations around the edge of the internet, rather than prioritising the transfer of some service providers' IP packets over others on the internet core.

ISP traffic prioritisation

- A1.24 A key area of potential internet congestion occurs on the shared fibre optic 'backhaul' connection between the access network and the ISP. The CDNs described above are unable to circumvent this potential congestion and some ISPs now offer a traffic prioritisation product to service providers on this part of their networks. These typically reserve a certain amount of capacity on the backhaul connection for prioritised services up to a certain connection speed. For example, a video on demand service provider might purchase from an ISP a traffic prioritisation product that ensures that its customers are always able to access a 1.5 MB/s connection needed to deliver high quality glitch free video even during periods of

high broadband capacity demand. This type of prioritised product is already used by the BT Vision video on demand service.

- A1.25 The impact of this prioritisation on the backhaul and access network and the resulting ability of consumers to access internet services that have not been prioritised depends on a number of factors:
- 1.25.1 the amount of excess backhaul capacity provided by the ISP which determines the amount of residual backhaul capacity available for non prioritised services,
 - 1.25.2 on wireless access networks, the number of users simultaneously accessing prioritised services in the same mobile transmitter cell which determines the total amount of residual wireless capacity available for accessing non prioritised services; and
 - 1.25.3 on fixed and wireless access networks, the maximum household broadband connection speed which determines the residual amount of connection speed available for use by non prioritised internet services in the same household.

Annex 2

Responding to this discussion

How to respond

- A2.1 Ofcom invites written views and comments on the issues raised in this document, to be made **by 5pm on 9 September 2010**.
- A2.2 Ofcom strongly prefers to receive responses using the online web form at <https://www.ofcom.org.uk/consult/condocs/net-neutrality/howtorespond/form>, as this helps us to process the responses quickly and efficiently. We would also be grateful if you could assist us by completing a response cover sheet (see Annex 4), to indicate whether or not there are confidentiality issues. This response coversheet is incorporated into the online web form questionnaire.
- A2.3 For larger responses - particularly those with supporting charts, tables or other data - please email traffic.management@ofcom.org.uk attaching your response in Microsoft Word format, together with a consultation response coversheet.
- A2.4 Responses may alternatively be posted or faxed to the address below, marked with the title of the discussion document.
- Stephanie Peat
Floor 6
Dept Strategy and market developments
Riverside House
2A Southwark Bridge Road
London SE1 9HA
- Fax: 020 7981 3706
- A2.5 Note that we do not need a hard copy in addition to an electronic version. Ofcom will acknowledge receipt of responses if they are submitted using the online web form but not otherwise.
- A2.6 It would be helpful if your response could include direct answers to the questions asked in this document, which are listed together at Annex 5. It would also help if you can explain why you hold your views and how Ofcom's proposals would impact on you.

Further information

- A2.7 If you want to discuss the issues and questions raised in this discussion, or need advice on the appropriate form of response, please contact Stephanie Peat on 020 7981 3896.

Confidentiality

- A2.8 We believe it is important for everyone interested in an issue to see the views expressed by respondents. We will therefore usually publish all responses on our website, www.ofcom.org.uk, ideally on receipt. If you think your response should be kept confidential, can you please specify what part or whether all of your response

should be kept confidential, and specify why. Please also place such parts in a separate annex.

- A2.9 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and will try to respect this. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.
- A2.10 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's approach on intellectual property rights is explained further on its website at <http://www.ofcom.org.uk/about/accoun/disclaimer/>

Next steps

- A2.11 Please note that you can register to receive free mail updates alerting you to the publications of relevant Ofcom documents. For more details please see: http://www.ofcom.org.uk/static/subscribe/select_list.htm

Ofcom's consultation processes

- A2.12 Ofcom seeks to ensure that responding to a consultation is easy as possible. For more information please see our consultation principles in Annex 3.
- A2.13 If you have any comments or suggestions on how Ofcom conducts its consultations, please call our consultation helpdesk on 020 7981 3003 or e-mail us at consult@ofcom.org.uk . We would particularly welcome thoughts on how Ofcom could more effectively seek the views of those groups or individuals, such as small businesses or particular types of residential consumers, who are less likely to give their opinions through a formal consultation.
- A2.14 If you would like to discuss these issues or Ofcom's consultation processes more generally you can alternatively contact Vicki Nash, Director Scotland, who is Ofcom's consultation champion:

Vicki Nash
Ofcom
Sutherland House
149 St. Vincent Street
Glasgow G2 5NW

Tel: 0141 229 7401
Fax: 0141 229 7433

Email vicki.nash@ofcom.org.uk

Annex 3

Ofcom's consultation principles

A3.1 Ofcom has published the following seven principles that it will follow for each public written consultation:

Before the consultation

A3.2 Where possible, we will hold informal talks with people and organisations before announcing a big consultation to find out whether we are thinking in the right direction. If we do not have enough time to do this, we will hold an open meeting to explain our proposals shortly after announcing the consultation.

During the consultation

A3.3 We will be clear about who we are consulting, why, on what questions and for how long.

A3.4 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 to give us a written response. If the consultation is complicated, we may provide a shortened Plain English Guide for smaller organisations or individuals who would otherwise not be able to spare the time to share their views.

A3.5 We will consult for up to 10 weeks depending on the potential impact of our proposals.

A3.6 A person within Ofcom will be in charge of making sure we follow our own guidelines and reach out to the largest number of people and organisations interested in the outcome of our decisions. Ofcom's 'Consultation Champion' will also be the main person to contact with views on the way we run our consultations.

A3.7 If we are not able to follow one of these principles, we will explain why.

After the consultation

A3.8 We think it is important for everyone interested in an issue to see the views of others during a consultation. We would usually publish all the responses we have received on our website. In our statement, we will give reasons for our decisions and will give an account of how the views of those concerned helped shape those decisions.

Annex 4

Response cover sheet

- A4.1 In the interests of transparency and good regulatory practice, we will publish all responses in full on our website, www.ofcom.org.uk.
- A4.2 We have produced a coversheet for responses (see below) and would be very grateful if you could send one with your response (this is incorporated into the online web form if you respond in this way). This will speed up our processing of responses, and help to maintain confidentiality where appropriate.
- A4.3 The quality of consultation can be enhanced by publishing responses before the consultation period closes. In particular, this can help those individuals and organisations with limited resources or familiarity with the issues to respond in a more informed way. Therefore Ofcom would encourage respondents to complete their coversheet in a way that allows Ofcom to publish their responses upon receipt, rather than waiting until the consultation period has ended.
- A4.4 We strongly prefer to receive responses via the online web form which incorporates the coversheet. If you are responding via email, post or fax you can download an electronic copy of this coversheet in Word or RTF format from the 'Consultations' section of our website at www.ofcom.org.uk/consult/.
- A4.5 Please put any parts of your response you consider should be kept confidential in a separate annex to your response and include your reasons why this part of your response should not be published. This can include information such as your personal background and experience. If you want your name, address, other contact details, or job title to remain confidential, please provide them in your cover sheet only, so that we don't have to edit your response.

Cover sheet for response to an Ofcom discussion

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)

Annex 5

Questions for discussion

- A5.1 We are seeking views on a range of questions and require responses by the 9 September 2010. This will allow us to take these views into account when we input into the European Commission's Consultation (expected to conclude by the end of September). The questions are set out below:
- i) How enduring do you think congestion problems are likely to be on different networks and for different players?
 - ii) What do you think are possible incentives for potentially unfair discrimination?
 - iii) Can you provide any evidence of economic and or consumer value generated by traffic management?
 - iv) Conversely, do you think that unconstrained traffic management has the potential for (or is already causing) consumer/citizen harm? Please include any relevant evidence.
 - v) Can you provide any evidence that allowing traffic management has a negative impact on innovation?
 - vi) Ofcom's preliminary view is that there is currently insufficient evidence to justify *ex ante* regulation to prohibit certain forms of traffic management. Are you aware of evidence that supports or contradicts this view?
 - vii) Ofcom's preliminary view is that more should be done to increase consumer transparency around traffic management. Do you think doing so would sufficiently address any potential concerns and why?
 - viii) Are you aware of any evidence that sheds light on peoples' ability to understand and act upon information they are given regarding traffic management?
 - ix) How can information on traffic management be presented so that it is accessible and meaningful to consumers, both in understanding any restrictions on their existing offering, and in choosing between rival offerings? Can you give examples of useful approaches to informing consumers about complex issues, including from other sectors?
 - x) How can compliance with transparency obligations best be verified?
 - xi) Under what circumstances do you think the imposition of a minimum quality of service would be appropriate and why?

Annex 6

Glossary

Access network. The 'last mile' communications link, which connects a subscriber to their service provider's network infrastructure. Access network technologies include dial-up, DSL, cable, wireless and fibre optics.

Anti-competitive discrimination. Business practices that prevent or reduce competition in a market by discriminating against one or more parties.

Application provider. A business that provides computer-based services to customers over a network, typically the internet or a mobile network.

App. An abbreviation of 'application' – computer software that provides additional functionality to the device it is installed on.

ARCEP (The Autorité de Régulation des Communications Électroniques et des Postes). The French national regulatory authority.

Backhaul. Network links that connect a service provider's edge network to their network core.

Bandwidth. Data transmission speed, typically expressed in kilobits or Megabits a second (kbps, Mbps)

BEREC (The Body of European Regulators of Electronic Communications). The new body for co-operation among European National Regulatory Authorities which provides advice to the European Institutions.

BitTorrent. A popular peer-to-peer file-sharing protocol. In common with other such protocols it tends to use a lot of network resources when active.

Broadband. A network service or connection which is capable of supporting always-on services and which provides the end-user with high data speeds. Typically applied to ADSL, cable and 3G internet access services.

CDN (Content Distribution Network). A network of strategically located computers containing copies of popular data such as video files, designed to provide optimised access to the data. Typically used for worldwide distribution of popular content so that access is not constrained by the capacity of national or international links.

Communications Act 2003. The Act, passed in July 2003 and as subsequently amended by legislation including the Digital Economy Act 2010, defines Ofcom's duties and powers.

Competition Act 1998. Provides an updated framework for identifying and dealing with restrictive business practices and abuse of a dominant market position.

Content provider. A service that provides access to content, typically video, audio and electronic publications.

Contention ratio. The number of customers sharing the amount of bandwidth equal to their individual 'headline' connection speed. For internet access services, average bandwidth use

is typically a fraction of the maximum available bandwidth. In order to provide a cost-effective service, bandwidth is usually provided on a shared, or contended, basis. The higher the contention ratio, the greater the number of users sharing the given amount of bandwidth. If an 8Mbps internet services is provided at a contention ratio of 50:1 there would 50 users sharing each 8Mbit/s of bandwidth.

Core network. The central part of a telecom network that handles the aggregated traffic from the access network. In an ISP, the core network passes traffic between the access network and the edge router, which makes the final connection to the internet.

CRTC (The Canadian Radio-television and Telecommunications Commission). The independent Canadian telecommunications regulator.

DPI (Deep Packet Inspection). A technology that allows network packets to be handled according to the content being conveyed, rather than simply by the IP addresses carried in the packet headers. Enables advanced network management, enhanced user services, and security functions such as blocking of spam as well as internet data mining, eavesdropping, and censorship. Although DPI technology has been used for Internet management for many years, some advocates of net neutrality fear that the technology may be used anti-competitively or to reduce the openness of the Internet.

DRM (Digital Rights Management) A generic term for control technologies that can be used by hardware manufacturers, publishers, copyright holders and individuals to impose limitations on the usage of digital content and devices.

E-Commerce. The buying and selling of products or services over electronic systems such as the Internet and other computer networks.

Enterprise Act 2002. Made major changes to UK competition law with respect to mergers and also changed the law governing insolvency bankruptcy.

EU Commission. The executive body of the European Union. The body is responsible for proposing legislation, implementing decisions, upholding the Union's treaties and the general day-to-day running of the Union.

European Parliament. The directly elected parliament of the European Union (EU).

Ex-ante regulation. Anticipatory intervention. Ex ante regulation uses government-specified controls to prevent socially undesirable actions or outcomes in markets, or direct market activity towards socially desirable ends.

Ex-post regulation. Addresses specific allegations of anti-competitive behaviour or market abuse. Ex post regulation aims to redress proven misconduct through a range of enforcement options including fines, injunctions, or bans.

FCC (The Federal Communication Commission). An independent agency of the United States government. The FCC works towards six goals in the areas of broadband, competition, the spectrum, the media, public safety and homeland security.

FSA (Financial Services Authority). An independent UK regulator in charge of regulating financial services.

FTC (Federal Trade Commission). An independent agency of the United States government. Its principal mission is the promotion of "consumer protection" and the

elimination and prevention of what regulators perceive to be harmfully "anti-competitive" business practices.

Gbit (Gigabit). A unit of digital information. 1 gigabit = 10^9 = 1,000,000,000 bits.

Internet. A global system of interconnected computer networks using the TCP/IP Internet Protocols to enable computers across the world to exchange data.

IP address (Internet Protocol Address). A numerical label that is assigned to a device participating in an Internet Protocol computer network. IP addresses perform functions similar to telephone numbers – they allow identification of a terminal and routing of traffic to it. Unlike telephone numbers, IP addresses are often allocated on a temporary basis.

ISP (Internet Service Provider). A business that provides Internet access services to its customers, enabling them to access the internet from home, work or on the move.

ITMP (Internet Traffic Management Practices). A term defined by the CRTC to cover the range of controls used to manage network traffic. Typically this is done to optimise or guarantee performance, improve latency, and/or increase usable bandwidth and can involve delaying packets fail to meet certain criteria.

Latency. The delay experienced by packets of data in travelling across a network. Network latency is usually measured in milliseconds (ms).

Malware (Malicious Software). Software designed to infiltrate a computer system and perform actions without the owner's informed consent. Types of malicious software include viruses, Trojans and rootkits.

MNO (Mobile Network Operator). A telephone company that provides services for mobile phone subscribers.

MPAA (The Motion Picture Association of America). The United States' trade association for the film industry.

Network congestion. Impairment to network connectivity due to excess traffic. Typically caused by traffic arriving at a router faster than the router can process it. Congestion effects can include the blocking of new connections and packet loss or delay.

NPTA (Norwegian Post and Telecommunications Authority). The independent Norwegian regulator of post and telecommunication services.

NRA's (National Regulatory Authorities). A public authority or government agency responsible for exercising autonomous authority over some area of human activity in a regulatory or supervisory capacity. An independent regulatory authority is a regulator that is independent from other branches or arms of the government.

Ofcom (The Office of Communications). The independent communications regulator and competition authority for the communication industries in the UK.

OFT (Office of Fair Trading). Is a non-ministerial government department which enforces both consumer protection and competition law.

Peer-to-Peer (P2P). A distributed system of computers allowing participants to communicate directly; that is without the use of an intervening server or host.

PTS (The Swedish Post and Telecoms Agency). The Swedish national regulatory authority.

Service provider. A body that provides services to other entities. Usually this refers to a business that provides subscription or web service to other businesses or individuals. Examples of these services include video on demand, music and web application hosting.

SME's (Small and Medium Enterprises). Companies whose headcount or turnover falls below certain limits. Such as, turnover must not exceed £25.9m and headcount no more than 250 employees.

SMP (Significant Market Power). An undertaking shall be deemed to 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.

Spam. Unwanted messages, generally email or SMS. The use of electronic messaging systems to send unsolicited bulk messages.

Spectrum. The entire range of electromagnetic radiation extending from very low frequency radio waves through radio and television broadcasting bands, mobile network allocations, microwave bands, infrared, the spectrum of visible light colours, ultra-violet, X-rays and finally gamma rays.

Streaming. The transmission of data for realtime use, as opposed to download and store. Typically used to deliver audio and video content that can be consumed as it is received.

TCP (Transmission Control Protocol). A core Internet protocol, TCP provides the reliable managed delivery of packets of data. Incorporates a system of error checking and acknowledgement that ensures missing or corrupt packets are resent.

Telemedicine. The use of interactive audiovisual media to deliver medical information for the purpose of consulting, and sometimes remote medical procedures or examinations.

Throttling. A method of traffic management that reduces the bandwidth of a service or protocol that is making excessive use of resources. Can for example be applied to a server, to reduce outgoing bandwidth at times of peak demand, or to a router to reduce the bandwidth of certain protocols in order to prioritise more urgent traffic.

Transmitter cell. A term used to describe the area of coverage of a wireless network transmitter. e.g. a mobile network base station.

VoD (Video-on-Demand). A service or technology that enables television viewers to individually select and watch programmes or films whenever they choose to, not restricted by a linear service.

VoIP (Voice over Internet Protocol). Telephone communications over an IP network such as the internet.

Wireless access networks. Any type of Access Network (see above) that is provided over a wireless link. These include 3G mobile networks, WiMAX, LTE and dedicated wireless links.