EUROPEAN PARLIAMENT

DIRECTORATE-GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT A
ECONOMIC AND SCIENTIFIC POLICY

Economic and Monetary Affairs

Employment and Social Affairs

Environment, Public Health and Food Safety

Industry, Research and Energy

Internal Market and Consumer Protection

Network Neutrality Revisited: Challenges and Responses in the EU and in the US

Study for the IMCO Committee

EN

2014

Network Neutrality Revisited: Challenges and Responses in the EU and in the US

DIRECTORATE GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICY

Network Neutrality Revisited: Challenges and Responses in the EU and in the US

STUDY

Abstract

This analytical study provides background on the debate over network neutrality, including (1) its technological, economic, and public policy aspects, and (2) the implications for European public policy going forward, including the position of the European Parliament on the Telecoms Single Market Regulation that was adopted in the first reading of the European Parliament in April 2014. It includes a comparison between the US, where these issues continue to be debated intensely, and the EU. It was provided by Policy Department A at the request of the Internal Market and Consumer Protection Committee (IMCO).

IP/A/IMCO/2014-02 December 2014

PE 518.751 EN

This document was requested by the European Parliament's Committee on the Internal Market and Consumer Protection.

AUTHOR

J. Scott Marcus

RESPONSIBLE ADMINISTRATOR

Mariusz MACIEJEWSKI
Policy Department Economic and Scientific Policy
European Parliament
B-1047 Brussels
E-mail: Poldep-Economy-Science@ep.europa.eu

LINGUISTIC VERSIONS

Original: EN

ABOUT THE EDITOR

Policy departments provide in-house and external expertise to support EP committees and other parliamentary bodies in shaping legislation and exercising democratic scrutiny over EU internal policies.

To contact Policy Department A or to subscribe to its newsletter please write to:
Poldep-Economy-Science@ep.europa.eu

Manuscript completed in November 2014

This document is available on the Internet at:
http://www.europarl.europa.eu/studies

DISCLAIMER

CONTENTS

LIST OF ABBREVIATIONS AND GLOSSARY

Access Access enables an operator to utilize the facilities of another operator in the furtherance of its own business and in the service of its own customers.

ADSL (Asymmetric Digital Subscriber Line) The most common technology for providing consumer broadband services over copper telephone lines.

Bandwidth The capacity of a channel to carry information, typically expressed in bits per second.

BEREC (Body of European Regulators for Electronic Communications)

Bitstream access The incumbent installs a high-speed access link to the customer premises, and makes this access link available to third parties (new entrants) over a shared access facility to enable them to provide high-speed services to customers.

Client-server An asymmetric technical implementation involving to computers whose functions are not the same. The software running on the customer's Personal Computer (PC) (often just a web browser) might be the client of software running on a server platform of the service provider. A single server can support a great many clients.

Deep packet inspection (DPI) A set of techniques for examining and categorising packets for any of a number of purposes. Unlike most other IP-based tools, DPI can be used to inspect not only the headers of IP datagrams, but also their application content (which also raises possible privacy concerns). DPI has been used to suppress peer-to-peer traffic.

Demand elasticity The response of demand to price (also referred to the *price elasticity of demand*). An increase in prices generally leads to lower demand, other things being equal.

DiffServ (Differentiated Services) An IP-based data communications protocol which enables hop-by-hop traffic management, whereby selected packets can be marked as having application requirements other than best efforts. It can be used as part of an implementation of Quality of Service (QoS).

Economic foreclosure Foreclosure (or *vertical foreclosure*) occurs when a firm that has market power in one segment attempts to project that market power into vertically related market segments where competition would otherwise lead to efficient outcomes.

FCC (Federal Communications Commission)The NRA for the United States.

FTTH Fiber-To-The-Home.

Gbps (Gigabit per second) One billion bits per second.

Interconnection Interconnection enables the customers of one network operator to establish and maintain communications with the customers of another network operator.

IP (Internet Protocol) The Internet Protocol is a data communications standard that allows computers to communicate with one another over digital networks. Together with the TCP protocol, IP forms the basis of the Internet.

IPTV (Television over IP) IPTV is the distribution of video programming (one way) by means of the Internet Protocol.

IPv4 (Internet Protocol, version 4) IPv4 is the current protocol for transmitting Internet Protocol datagrams over the Internet, using a 32-bit address system.

IPv6 (Internet Protocol, version 6) IPv6 is the emerging protocol for transmitting Internet Protocol datagrams over the Internet, using a 128-bit address system.

ISP (Internet Service Provider) An ISP is a network operator that enables other organisations or individuals to connect to the global Internet.

Jitter Variability of delay for Internet packets.

Kbps (kilobit per second) One thousand bits per second.

Latency Delay for Internet packets.

LLU (Local Loop Unbundling) A copper pair (or equivalent) is rented to a third party for its exclusive use.

Mbps (Megabit per second) One million bits per second.

MNO (Mobile Network Operator)

MPLS (Multi Protocol Label Switching) A data communications protocol developed by the Internet Engineering Task Force (IETF). MPLS seeks to reduce the complexity of IP-based networks, and thus to improve the performance of routers in ISP backbones. It can be used to support traffic engineering as part of an implementation of Quality of Service (QoS).

Net Neutrality or Network Neutrality A proposed regulatory principle that seeks to limit (harmful or anticompetitive) discrimination on the part of network operators (ISPs). Different definitions exist, with different and not altogether compatible implications for public policy.

Network Externality or Network Effect Where network effects are present, the value of a network to its end users can be greater as the number of participants in the network increases. These effects go beyond pure economies of scale.

Network Provider Network operator.

NGN (Next Generation Network) The ITU defines a Next Generation Network as "… a packet-based network able to provide services including Telecommunication Services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It offers unrestricted access by users to different service providers. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users."

NRA (National Regulatory Authority)

NRIC (the Network Reliability and Interoperability Council) The NRIC is an industry advisory council to the US national regulatory authority, the FCC.

OECD	(Organisation for Economic Cooperation and Development)
OSI	(Open Systems Interconnection) Reference Model: A layered data communications protocol model.
Packet drop discipline	The order in which a router drops packets if the number of packets exceeds the memory available for a queue. Note that dropping packets is a normal event for an IP network under load, not necessarily a failure mode.
Packet filtering	A technique for dropping packets (i.e. not allowing them through) or otherwise applying special handling based on defined criteria, which could be quite complex. It is often used to block harmful content.
Packet loss	The probability that a packet never reaches its destination. This could be due to transmission errors, but errors are quite rare in modern fibre-based fixed networks. More often, packets are lost because the number of packets waiting for transmission is greater than the available storage capacity (buffers). See also the definition of 'packet drop discipline'.
Peer to peer	(P2P) A system where the end users typically have a symmetric relation-ship with one another.
Peering	The arrangement whereby ISPs exchange traffic for their respective customers (and for customers of their respective customers), but not for third parties. Peering is a substantially symmetric form of network interconnection.
Propagation delay	The time that it takes for light or electricity to reach its destination in a network. This is a function of the distance that the signal must travel, and the speed of light in the medium employed (typically wire or fibre).
QoE	(Quality of Experience) Quality of service as perceived by the end-user, in light of the task that the end user is seeking to accomplish.
QoS	(Quality of Service) In an IP-based environment, QoS often denotes measures of throughput, delay, variability of delay, and the probability of packet loss.
Queuing	The need for one packet of data to wait for another in order to gain access to a shared facility. These delays can be analysed using a branch of mathematics known as queuing theory.
Queuing delay	The time that a packet waits before being transmitted. Both the average delay and variability of delay (jitter) matter, since the two together establish a confidence interval for the time within which a packet can be expected to arrive at its destination.
Queuing theory	A branch of mathematics that studies waiting lines.
Ramsey-Boiteux pricing	A pricing principle whereby the service provider takes the highest price mark-ups on those services that have lowest demand elasticity, that is, where the tendency of high prices to diminish demand is least.

Shared access	Enables the incumbent to continue to provide telephony service while the new entrant delivers high-speed data services over that same local loop.
Simple resale	A new entrant receives and sells to its end users a product that is commercially similar to the DSL product provided by the incumbent to its own retail customers.
SMP Significant Market Power	A firm is "… 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." (Framework Directive)
TCP/IP Reference Model	The layered data communications protocol model used by the Internet.
Telecoms Single Market Regulation	The Telecoms Single Market (TSM) legislative package was put forward by the European Commission as a 'Regulation laying down measures concerning the European single market for electronic communications and to achieve a Connected Continent (COM(2013)627final)', and was passed by the European Parliament at First Reading on 4 April 2014.
Traffic prioritisation	In the context of an IP network, the process of determining the order in which each packet (IP datagram) is transmitted from a router's outbound queue for a particular transmission link.
Transit	The arrangement whereby an ISP carries traffic for a customer (and, if the customer is an ISP rather than an end-user, for customers of its customer). Transit generally includes carriage of traffic destined for third parties, not just for the ISPs own customers. Transit is a substantially asymmetric form of network interconnection.
Transmission Control Protocol	(TCP) A data communications protocol used to assure reliable delivery of data in an IP network.
TSM Regulation	See *Telecoms Single Market Regulation*.
Two-sided market	In a two-sided market, a two-sided platform provider seeks to serve both sides of the market. The structure of prices matters, not just their levels. (See Tirole and Rochet (2004).)
VoD	(Video on Demand) Video on Demand enables end-users to select and watch video content over a network.
VoIP	(Voice over IP) A set of data communications protocols and technologies to enable voice to be sent over individual IP-based networks or over the Internet.
VPN	A virtual private network.

LIST OF BOXES

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

As the Internet has come to play an increasingly important role in the European and global economy, concerns have been expressed about the potential risk that firms (especially vertically integrated broadband network operators with market power) might exploit their control over the network to inappropriately discriminate among different kinds of traffic. This discrimination, it is argued, could enable the firms to thwart consumer choice and to unfairly expropriate the benefits that should otherwise flow to consumers. These concerns have led to a debate, in Europe and elsewhere, over *network neutrality*.

Background

There are many different definitions of network neutrality.

- The ability of all Internet end-users '… to access and distribute information or run applications and services of their choice'.[1]
- Assurance that all traffic on the Internet is treated equally,[2] whatever its source, content or destination. More recently, the TSM Regulation as adopted in the first reading of the European Parliament in April 2014 defines the principle of net neutrality in the open Internet as signifying 'that traffic should be treated equally, without discrimination, restriction or interference, independent of the sender, receiver, type, content, device, service or application.'
- Absence of *unreasonable discrimination* on the part of network operators in transmitting Internet traffic.[3]
- In his recent video remarks regarding network neutrality, US President Obama spoke of 'openness, fairness, and freedom' and of the absence of gatekeepers who can decide which sites users are permitted to access.[4]

The differences in these definitions, which are visible on both sides of the Atlantic, reflect (1) whether they express what users of the network must be enabled to do, versus what providers of the network are prohibited from doing; and (2) whether they seek to broadly limit differentiated treatment in general, versus imposing a more limited restriction on harmful or anticompetitive discrimination. These definitional differences are not a mere matter of semantics. There is substantial tension if not outright incompatibility among them, even though all of them enjoy substantial popular support in various quarters.

Network neutrality in the Internet poses complex questions, at the technical, at the economic and at the policy level.

---

1 This is the definition set forth in Article 8 of the Framework Directive (Directive 2002/21/EC on a common regulatory framework for electronic communications networks and services (Framework Directive) as amended by Directive 2009/140/EC (Better Regulation Directive)), a key element of the European Regulatory Framework for Electronic Communications.

2 'To BEREC, "net neutrality" describes the principle of equal treatment of network traffic.' BEREC (2012), 'Summary of BEREC positions on net Summary of BEREC positions on net Summary of BEREC positions on net neutrality', BoR (12) 146.

3 See, for instance, paragraph 1 of the US FCC (2010), Preserving the Open Internet (GN Docket No. 09-191) / Broadband Industry Practices (WC Docket No. 07-52), FCC 10-2010, released 23 December 2010, which we will refer to from now on as the FCC's 2010 Open Internet Order. In the 2014 'Open Internet' Notice of Proposed Rulemaking, the FCC follows a slightly different line, instead restricting network management to 'commercially reasonable' practices (as we explain in Chapter 5). See also the European Commission's 2010 *Report on the public consultation on 'The open internet and net neutrality in Europe'*, which considers the degree to which there might be a problem with '… unfair discrimination in a way that harms consumers or competition.'

4 Barack Obama (2014), at http://www.whitehouse.gov/net-neutrality, viewed 23 November 2014.

A technological view of network neutrality

Much of the network neutrality discussion has focussed on *blocking* of traffic, and on *prioritisation* of traffic, to or from specific destinations or applications.

To understand prioritisation (and to some extent blocking), one must understand the complex role that network performance plays in networks based on the *Internet Protocol (IP)*. Some Internet applications are far more sensitive to network performance (delay, variability of delay, and the probability of loss of packets) than others. These technical aspects, often collectively termed *Quality of Service (QoS)*, strongly influence the user's perceived *Quality of Experience (QoE)*.

Network operators may have sound technical and business reasons for prioritising traffic for delay-sensitive uses (such as real time *Voice over IP [VoIP],* gaming, videoconferencing, or mission-critical traffic for public protection and disaster relief (PPDR), transport, or health) over less-delay-sensitive traffic (e.g. e-mail or file sharing).

It is sometimes claimed that differentiated QoS somehow violates core principles of the Internet (such as the end to end principle). In reality, differentiated QoS was always a design consideration for the Internet (although not initially fully implemented). Its rich history goes back to the earliest days of the Internet and its predecessor networks.

An economic view of network neutrality

There are at least three distinct economic views of network neutrality, based on (1) quality and price discrimination, (2) two-sided markets, and (3) economic foreclosure. The first two of these suggest that non-neutrality is positive or neutral to consumers and suppliers, while the third says that it can under some circumstances be harmful.

Quality differentiation and *price differentiation* are well understood practices that, in the absence of anticompetitive discrimination, often benefit both producers and consumers;[5] however, differentiation can be used in harmful ways where market power is present.

In an alternative and equally relevant view, Internet Service Providers can viewed as collectively functioning as a *two-sided platform* connecting providers of content with end-users who consume that content.[6] Under this view, some disputes are simply about the division of revenue and profits between the platform provider (i.e. the network operators collectively) and the two sides of the market.

In a third view, a producer with market power in one segment may attempt to project that market power into upstream or downstream segments that would otherwise be competitive (a practice known as *economic foreclosure*). Economic foreclosure harms consumers and can impose an overall socio-economic *deadweight loss* on society.

Quite a bit of work on network neutrality has been done by the economists over the past ten years (see Section 3.5). A number of papers suggest that, for competitive markets (taking into account the effects of regulation in place), market based solutions are likely to be superior to imposed regulatory solutions (such as an obligation not to charge for interconnection) because the regulatory solutions necessarily ignore market signals. Otherwise, these results are largely inconclusive.

---

5 Harold Hotelling, 'Stability in Competition', *The Economic Journal*, March 1929, pages 41-57.

6 Rochet, Jean-Charles/ Tirole, Jean (2004): Two Sided Markets : An Overview, March 2004, available at: http://faculty.haas.berkeley.edu/hermalin/rochet_tirole.pdf.

Harms and benefits associated with network neutrality deviations

Network neutrality has attracted a great deal of attention in recent years. This is understandable, inasmuch as it represents not only a threat to consumer welfare, but also to fundamental freedoms in an increasingly digital world. How big a problem is it in reality?

The *Body of European Regulators for Electronic Communications (BEREC)* and the Member State *National Regulatory Authorities (NRAs)* that comprise it do not view network neutrality as representing an unmanageable challenge (see Section 6.1.2). 'For the time being, the situation appears to be mostly satisfactory and problems are relatively rare, though this assessment should be nuanced, as the situation varies significantly between national markets. … BEREC is committed to the open Internet, and believes that the existing regulatory tools, when fully implemented, should enable NRAs to address net neutrality-related concerns.'[7]

Traffic management can have positive effects. It plays a large role in the successful introduction of Voice over IP (VoIP) in the United States. Cooper (2013) reports: 'One US cable engineer described how the impact of peer-to-peer traffic on customers of Vonage, a leading US VoIP provider, became an impetus for adopting peer-to-peer management: "We had constant calls from Vonage management, customers pissed off, that we were degrading Vonage's service. … [W]e knew that if we did some stuff in the network we could make that experience better. Demonstrably better."'[8] At the same time, European MNOs appear to be more likely today to disadvantage VoIP than to favour it, suggesting that they are practicing a form of economic foreclosure against VoIP services that compete with their own voice services.

Various other applications could appropriately benefit from traffic prioritisation, including videoconferencing, certain forms of gaming, and mission-critical traffic for public protection and disaster relief (PPDR), transport, or health.

Concerns that network operators would choose to favour prioritised and/or specialised services so as to make non-prioritised services unattractive or unusable seem to be speculative or overblown (see Section 4.7). Threats to freedom of expression are a serious concern worldwide, but do not seem to require exceptional network neutrality measures within Europe (see again Section 4.7).

Stakeholder views on network neutrality

The European Commission conducted a public consultation on network neutrality at the end of 2012, with an eye to a legislative initiative in 2013. The Commission never published a comprehensive analysis of the results of that public consultation. We evaluated the 131 non-confidential textual stakeholder responses for this report.[9]

Citizens were troubled by most forms of traffic management, but troubled by some forms more than by others. By contrast, most organisational stakeholders considered traffic management to be appropriate under suitable preconditions, although different perspectives were visible among NRAs, ISPs, content providers, and consumer advocates. Many expressed concerns with blocking legitimate content or applications, unreasonably degrading services, or impeding services competing with the ISP's own services.

[7] BEREC (2012), 'Summary of BEREC positions on net neutrality', BoR (12) 146. This BEREC position has been broadly consistent for many years, and continues to be visible in BEREC's 2014 pronouncements.

[8] Alissa Cooper (2013), How Regulation and Competition Influence Discrimination in Broadband Traffic Management: A Comparative Study of Net Neutrality in the United States and the United Kingdom.

[9] We gratefully acknowledge the Commission's assistance in tabulating more than 400 multiple choice responses to the same public consultation.

Organisational respondents agreed that for a network operator to prioritise its own traffic ahead of traffic for applications that compete with its own services is problematic.

Consumer advocates and other civil society organisations appear to be deeply troubled by limitations on Voice over IP (VoIP). The views of network operators on restrictions on VoIP and peer-to-peer (P2P) applications differed greatly from those of applications providers.

Some stakeholders saw an urgent need for legislative and/or regulatory measures, while others (including BEREC and most NRAs) felt that current instruments were sufficient. Many stakeholders felt that for the Member States to implement divergent approaches would carry substantial risk.

Markets and regulation in the U.S and in the European Union

The US regulatory approach to network neutrality that is likely to emerge shortly responds to different circumstances than those relevant to Europe. The overall US regulatory approach is partly a cause, and partly a response, to a very different marketplace.

Most US homes are able to receive broadband from either a cable television provider or a telecommunications provider; however, deregulation has resulted in the disappearance of competitive providers (using LLU or shared access) in the US, resulting in an essentially duopolistic market environment, as the FCC itself has acknowledged (see Section 6.2.1).

The same deregulation makes it difficult or impossible for the FCC to take action on network neutrality. The FCC's new 2014 Open Internet proceeding seeks to reinstate network neutrality protections that were put in place in 2010 but invalidated by the courts.

By contrast, even though many European homes are served by only a single fixed telecommunications network operator, many Europeans nonetheless have the opportunity to be served by any of a number of broadband providers (see Section 6.2.2) thanks to a generally effective regulatory framework for last mile fixed network access in Europe (based on LLU, shared access and bitstream). The richer competitive market structure in Europe, together with a more robust regulatory and competition law environment, has likely contributed to the low level of network neutrality incidents that have been observed in Europe to date.

As part of the review of the regulatory framework enacted in 2009, the European Union put in place measures (1) to ensure that consumers are informed of the relevant practices of their network operators, and can switch network operators without direct penalty if they are dissatisfied with a change in those practices; (2) to empower national regulators to impose minimum QoS standards on network operators should it prove necessary; and (3) to establish the right of end-users to access content, applications or services of their choice as an explicit goal of European policy (see Section 6.1.2).

The European Commission's 2013 decision to include network neutrality as part of a Telecoms Single Market Regulation was apparently inspired by concern over a possible proliferation of potentially inconsistent or incompatible legislation at Member State level (as enacted by the Netherlands in 2011, and by Slovenia in 2013), not by concerns that the NRAs lacked authority to deal with network neutrality issues.[10]

[10] See, for instance, the European Commission's 2013 Impact Assessment for the Telecoms Single Market Regulation: 'Absent clear and predictable rules at EU level, some EU Member States have begun to adopt their own approaches regarding traffic management practices (often referred to as 'net neutrality'). Regulatory measures have been developed at national level ranging from nonbinding instruments (self-regulatory measures in the United Kingdom and Denmark) and more elaborated guidelines (NRA guidance in France) to the enactment of specific legislation on net neutrality (the Netherlands and Slovenia). Additionally, Germany is planning to adopt legislative proposals in the near future. Several initiatives have been announced or are under

Reflections for the Parliament to consider going forward

In the recommendations in our 2011 study of network neutrality for the European Parliament,[11] we struck a cautious note toward the overall approach to be taken. This author is still of the view '… that it is important to avoid inappropriate, disproportionate, or premature action. … Preventative measures for threats that may or may not appear risk doing more harm than good.'

Actual network neutrality incidents still appear to be rare. As recently as June of 2014, BEREC noted that 'very few NRAs have reported specific relevant net neutrality incidents.'[12] Some, however, might disagree with that assessment (see Section 4.3.1 and Section 5.4).

Meanwhile, it is important to ensure that any approach that is taken is sufficiently future proof. There is considerable uncertainty as to the future evolution of the Internet value chain.[13] An overly rigid regulatory response might easily lock Europe in prematurely.

The need for caution applies with equal or greater force to actions taken at Member State level, with the attendant danger of a proliferation of inconsistent and possibly incompatible approaches to network neutrality across Europe (see especially Sections 5.8 and 6.1.2).

We would like to highlight the following topics as being likely to emerge in the course of negotiations between Council and Parliament.[14]

- **What form of legislative instrument should be used?** This has already been debated within Council.[15] A Regulation may possibly be the best way to prevent divergent approaches in the Member States, but is also inflexible.
- **Irrespective of the form of legislative instrument, does it strike the right balance in preventing harmful divergence among the Member States, while providing appropriate flexibility and respect for subsidiarity?**
- **Are all terms defined with adequate clarity?**
- **Does the instrument strike the right balance in preventing harmful differentiation, while permitting non-harmful differentiation, however defined?**
- **Does the legislative measure enable appropriate use of *managed services*, and prevent inappropriate use?**[16] Is it indeed meaningful to speak of managed services as being distinct from general Internet services?

---

preparation in other Member States. This could result in further fragmentation of the Single Market that significantly complicates the integrated management of multi-territorial networks.'

[11] J. Scott Marcus, Pieter Nooren (TNO) and Jonathan Cave (RAND), 'Network Neutrality: Challenges and responses in the EU and in the U.S.' available at: http://www.europarl.europa.eu/activities/committees/studies/download.do?language=en&file=36351.

[12] BEREC (2014), 'BEREC Annual Reports – 2013', BoR (14) 60.

[13] BEREC (2014b), 'Work Programme 2015', BoR (14) 120.

[14] Hellenic Presidency (2014), 'Progress Report: Proposal for a Regulation of the European Parliament and of the Council laying down measures concerning the European single market for electronic communications and to achieve a Connected Continent, and amending Directives 2002/20/EC, 2002/21/EC and 2002/22/EC and Regulations (EC) No 1211/2009 and (EU) No 531/2012', 10109/14, 26 May 2014. This assessment is more helpful for our purposes than the rapidly changing statements from the Italian Presidency.

[15] 'While all delegations supported the principle of open internet (art. 23), views differed as to whether it is the right moment in time to regulate this issue now and whether to address it in this Regulation or in the Universal Service Directive or to even introduce in a 'soft' instrument, such as Recommendation or BEREC guidelines.' Hellenic Presidency (2014), op. cit.

[16] See also the report of the Hellenic Presidency (2014), op. cit.: 'While delegations agreed that the right balance needs to be struck between net neutrality and reasonable traffic management, they had different views on how to achieve it.'

- **Does the legislative measure enable prioritisation of services that legitimately need it, potentially including real time voice and videoconferencing over the public Internet, mission critical services (including public protection and disaster relief (PPDR), and transport), and health?**
- **Does the legislative measure do enough to prevent continued impediments to voice over IP (and videoconferencing over IP)?** These impediments are often complex or subtle. This has been a long-standing concern, and was noteworthy in comments of many stakeholders (see Section 5.4.3).
- **Does the legislative measure appropriately balance costs against benefits?** Legislative measures should consider not only the potential harms associated with quality differentiation, but also the potential benefits (see for instance Sections 4.1 and 4.4).
- **Does the legislative measure appropriately balance costs and benefits among the stakeholders?**[17]
- **Is the legislative measure sufficiently future proof and technologically neutral?** It is important that a legislative measure not lock Europe into a structure that risks being quickly outdated. Is the legislative measure overly prescriptive?

[17] See the Hellenic Presidency (2014), op. cit. 'Some delegations also highlighted that the right balance had to be struck also with regard to rights of end users on the one hand and the burden for operators on the other hand.'

1. INTRODUCTION

KEY FINDINGS

- There are many different definitions of network neutrality. The differences in these definitions, which are visible on both sides of the Atlantic, reflect (1) whether they express what users of the network must be enabled to do, versus what providers of the network are prohibited from doing; and (2) whether they seek to broadly limit differentiated treatment in general, versus imposing a more limited restriction on harmful or anticompetitive discrimination.
- This is a difficult and contentious topic. Throughout this study, we have sought to provide clear findings, while recognising that it is impossible to satisfy the needs and interests of all stakeholders.
- Network neutrality addresses a wide range of potential threats to consumer welfare, not all of which have been seen in practice.

The European Parliament's Committee on the Internal Market and Consumer Protection (IMCO) has requested an update to a 2011 study on net neutrality that this author had the privilege of leading.[18] In particular, we have been asked to review:

- the recent evolution of technological and business models interacting with the area of net neutrality as well as
- the recent evolution of the legislative frameworks both in the Member States and in the United States.

This current study seeks to provide an updated view of the relevant technological, economic, and public policy principles underlying the network neutrality debate. It also provides an updated view of regulatory and market developments both in the EU and in the United States, bolstered not only by literature review but also by interviews with key stakeholders.

We feel that the study is important and timely as Council and Parliament seek to reach final agreements on the *Telecoms Single Market Regulation (TSM)* that the Parliament passed at First Reading on 4 April 2014.[19] Our terms of reference also call on us to provide '… useful background for the examination of the proposal for a Regulation laying down measures concerning the European single market for electronic communications and to achieve a Connected Continent (COM(2013)627final), as work on this dossier is most likely to continue after the European elections.'

This study seeks to provide background on the debate over network neutrality: its technological, and economic, and public policy underpinnings, and the legal, regulatory,

[18] J. Scott Marcus, Pieter Nooren (TNO) and Jonathan Cave (RAND), 'Network Neutrality: Challenges and responses in the EU and in the U.S.' available at: http://www.europarl.europa.eu/activities/committees/studies/download.do?language=en&file=36351.

[19] European Parliament (2014), European Parliament legislative resolution of 3 April 2014 on the proposal for a regulation of the European Parliament and of the Council laying down measures concerning the European single market for electronic communications and to achieve a Connected Continent, and amending Directives 2002/20/EC, 2002/21/EC, 2002/22/EC, and Regulations (EC) No 1211/2009 and (EU) No 531/2012 (COM(2013)0627 – C7-0267/2013 – 2013/0309(COD)) (Ordinary legislative procedure: first reading).

and policy responses that have been attempted and that are currently in play in the EU and in the United States.

1.1. A complicated and contentious topic

Even if obvious, it is worth noting at the outset that network neutrality is (1) complex, (2) contentious, and (3) important.

If network neutrality was already a complex and contentious topic at the time of our previous 2011 study, it is even more so today. As Internet becomes increasingly crucial to the everyday life of all Europeans, the immediacy of the issue and the political relevance inevitably grow.

Furthermore, network neutrality is increasingly intertwined with issues of freedom of expression (see also Sections 1.3 and 4.7.3). Within Europe and worldwide, the Internet increasingly plays the role that a free press and free broadcast media played in the twentieth century. For the public to be concerned over any possible restrictions on free speech is understandable and altogether appropriate.

In order to gain a comprehensive understanding of network neutrality, it is necessary to understand the underlying principles of network neutrality at a technical, economic, and public policy level. These aspects interact with one another in complicated ways. We have sought to provide the necessary background in Chapters 2, 3, and 4, respectively. One must also understand how and why network neutrality manifests differently in the United States than in Europe, as we have attempted to clarify in Chapter 6.

There are a very wide range of views on the topic of network neutrality – no paper that makes clear statements on network neutrality can hope to please all readers, nor to serve the interests of all stakeholders. There is thus a great temptation to avoid clear pronouncements.

Bearing in mind that our terms of reference call on us to provide '… clear conclusions and recommendations for the European Parliament as a policy maker for the area of net neutrality …', we have nonetheless chosen to endeavour to organise and summarise this complex material, to present the material fairly and objectively, and to provide concrete findings and reflections based on an intensive review of the facts that are known. Not everyone will agree with our findings.

1.2. The definition of net neutrality

What constitutes network neutrality? Several definitions are in current use:

- The ability of all Internet end-users '… to access and distribute information or run applications and services of their choice'.[20]
- Assurance that all traffic on the Internet is treated equally,[21] whatever its source, content or destination. More recently, the Telecoms Single Market Regulation as passed by the Parliament in April 2014 defines the principle of net neutrality in the open Internet as signifying 'that traffic should be treated equally, without

[20] This is the definition set forth in Article 8 of the Framework Directive (Directive 2002/21/EC on a common regulatory framework for electronic communications networks and services (Framework Directive) as amended by Directive 2009/140/EC (Better Regulation Directive)), a key element of the European Regulatory Framework for Electronic Communications.

[21] 'To BEREC, "net neutrality" describes the principle of equal treatment of network traffic.' BEREC (2012), 'Summary of BEREC positions on net Summary of BEREC positions on net Summary of BEREC positions on net neutrality', BoR (12) 146.

discrimination, restriction or interference, independent of the sender, receiver, type, content, device, service or application.'

- Absence of *unreasonable discrimination* on the part of network operators in transmitting Internet traffic.[22]
- In his recent video remarks regarding network neutrality, US President Obama spoke of 'openness, fairness, and freedom' and of the absence of gatekeepers who can decide which sites users are permitted to access.[23]

These definitional differences are crucial, and they are not a mere matter of semantics. There is substantial tension if not outright incompatibility among these definitions, even though all of them enjoy substantial popular support in various quarters. They differ in (1) the degree of focus on access, versus the *quality* of access, versus the *price* of access to content and applications; (2) whether one should be concerned with all forms of quality differentiation or only with those forms of differentiation that are anticompetitive, discriminatory, or otherwise unreasonable; and (3) what might constitute a valid justification for quality differentiation.[24] The differences in these definitions, which are visible on both sides of the Atlantic, reflect (1) whether they express what users of the network must be enabled to do, versus what providers of the network are prohibited from doing; and (2) whether they seek to broadly limit differentiated treatment in general, versus imposing a more limited restriction on harmful or anticompetitive discrimination.

The use of various forms of *quality differentiation* for Internet traffic has been routine for decades. The net neutrality discussion has focussed on quality differentiation on the part of the network operator, but quality differentiation can just as well be implemented by other technical means that do not necessarily depend on the network operator, including *Content Delivery Networks (CDNs)*, and more generally by *caching* and *replication* of content, as we explain in Chapter 2. As we explain in Chapter 3, this differentiation serves in most cases (but not necessarily in all) to benefit not only network operators and service providers, but also consumers.[25]

A key question, then, is whether European policymakers should concern themselves with all forms of blockage and quality discrimination, or whether they should instead focus on *harmful forms*. This author considers the latter approach to preferable.

---

[22] See, for instance, paragraph 1 of the US FCC (2010), Preserving the Open Internet (GN Docket No. 09-191) / Broadband Industry Practices (WC Docket No. 07-52), FCC 10-2010, released 23 December 2010, which we will refer to from now on as the FCC's 2010 Open Internet Order. In the 2014 'Open Internet' Notice of Proposed Rulemaking, the FCC follows a slightly different line, instead restricting network management to 'commercially reasonable' practices (as we explain in Chapter 5). See also the European Commission's 2010 *Report on the public consultation on 'The open internet and net neutrality in Europe'*, which considers the degree to which there might be a problem with '… unfair discrimination in a way that harms consumers or competition.'

[23] Barack Obama (2014), at http://www.whitehouse.gov/net-neutrality, viewed 23 November 2014.

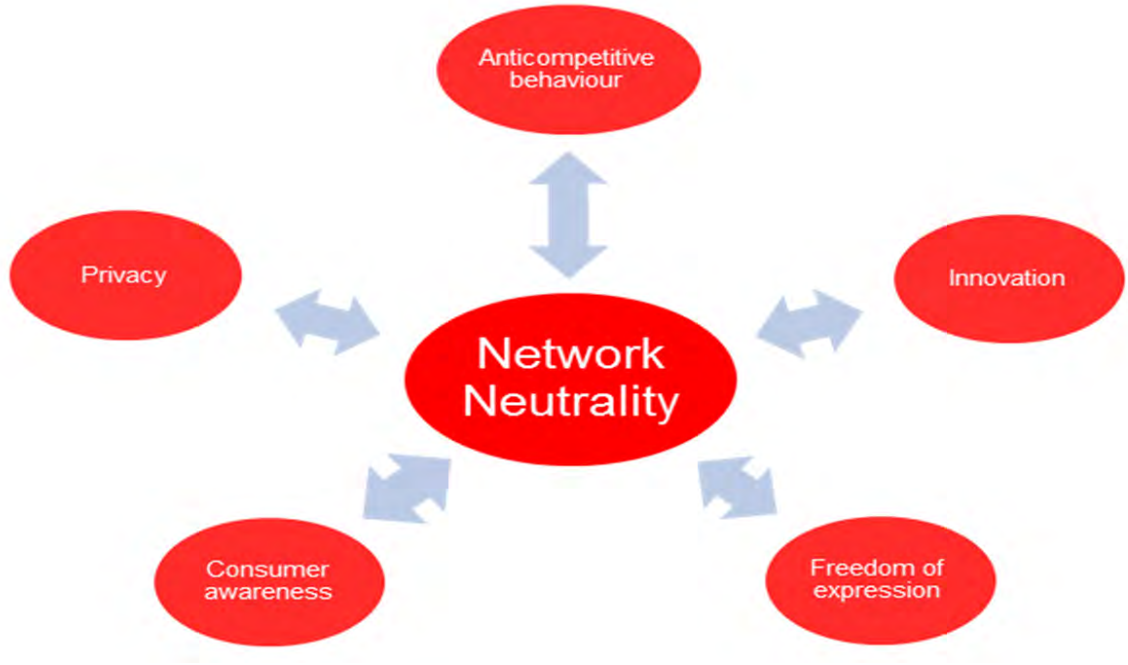
[24] Distinguishing reasonable from unreasonable discrimination is, of course, a huge challenge in its own right.

[25] It is worth noting at this point that the concern here is not only with traditional text and audio-visual content, but also with services such as search engines (such as Yahoo, Google, and Bing) and voice over IP (such as Skype and Viber).

1.3. The many faces of network neutrality

Network neutrality could be said to be at the heart of a web of crucial issues that appropriately concern European citizens.

Figure 1: Network neutrality is at the heart of a web of important public concerns



Source: Marcus

Departures from network neutrality in the form of unreasonable discrimination could raise a number of quite distinct potential issues of societal welfare. Consider for example:

- **Anticompetitive behaviour:** Is there a risk that a network operator with significant market power (SMP) might project its market power into upstream or downstream market segments that would otherwise be competitive?
- **Innovation and investment:** Might a network operator (especially a vertically integrated network operator that possesses some form of market power) act as a gatekeeper, inhibiting the ability of content providers or application service providers with which it competes from offering new, innovative products or services? Conversely, might the inability of network operators to offer differentiated network services inhibit the emergence of applications and content that depend on those services?
- **Freedom of expression:** Might a network operator interfere with the ability of its customers to express views with which the network operator disagrees?[26]
- **Consumer awareness, empowerment, and protection:** Do consumers understand the service that is being offered to them, and are they receiving the service that has been committed?

[26] As a possible example, a large US broadband provider was alleged in 2004 to have systematically filtered all email messages to its subscribers whose content contained the URL of a coalition of activists who oppose the war in Iraq. The details and possible motivation of the incident remain unclear.

- **Privacy and data protection:** To the extent that a network operator treats some Internet traffic differently from other traffic, does this necessarily imply that the network operator is delving more deeply than it should into the user's personal affairs (e.g. by means of *Deep Packet Inspection [DPI]*)?

In addition, there are linkages to network and information security, broadband policy, Internet governance, and more.

These issues are more subtle and complex than one might initially assume. The answers to some of the questions implicitly posed here might seem at first blush to be black and white, but in practice all are in varying degrees rather grey.

1.4. The views of stakeholders

Again, our terms of reference call on us to provide '… useful background for the examination of the proposal for a Regulation laying down measures concerning the European single market for electronic communications and to achieve a Connected Continent (COM(2013) 627 final), as work on this dossier is most likely to continue after the European elections.' An assessment along these lines needs to rest on a solid understanding of stakeholder views and practices.

Normally, a public consultation would represent a crucial input to the Impact Assessment for a major legislative initiative like the TSM. As is well known, the Commission deviated from its normal practice in this case, and no overall public consultation was conducted.[27]

As it happens, however, the Commission *did* conduct a public consultation on network neutrality at the end of 2012, with an eye to a legislative initiative in 2013. For whatever reason, the Commission never published a comprehensive analysis of the results of that public consultation.[28] Nonetheless, the 131 non-confidential textual stakeholder responses are publicly available, and generally are thoughtful and of high quality. It is therefore possible to effectively complete the public consultation today, and thus to build this report on a firmer foundation than would otherwise be possible.

We gratefully acknowledge the Commission's prompt and helpful assistance in processing the more than 400 multiple choice responses from the public consultation.

1.5. Structure of the remainder of this report

Chapter 2 provides the technical principles that underlie network neutrality, while Chapter 3 provides the economic and Chapter 4 the public policy principles that underlie network neutrality. Chapter 5 constitutes an abbreviated Consultation Report, basic on the publicly available results from the European Commission's late 2012 online Public Consultation (as explained in Section 1.4). Chapter 6 provides a detailed comparison between the market, the regulatory environment, and the competition law environment in Europe and those in the United States. It includes a detailed discussion of public policy responses to network neutrality that have been attempted or are under discussion. Chapter 7 provides findings and conclusions, and reflections for the Parliament going forward.

[27] European Parliament Impact Assessment Unit (2013), 'Initial appraisal of a European Commission Impact Assessment European Commission proposal on a European single market for electronic communications and to achieve a Connected Continent'.

[28] A one page summary appears in the Impact Assessment Report. So far as we can determine, no other analysis was ever published.

2. TECHNICAL PRINCIPLES UNDERLYING QUALITY DIFFERENTIATION IN THE INTERNET

KEY FINDINGS

- Quality discrimination was not a major issue for traditional fixed voice networks, but it is very much an issue for IP-based networks.
- Quality of Service (QoS) in an IP-based network reflects many variables, notably including the average and variance of queuing delay; propagation delay; and the probability of packet loss.
- The user's Quality of Experience (QoE) is largely a function of these same parameters, but is heavily dependent on the particular application that the user is making of the network. Some applications (especially Voice over IP (VoIP)) are much more sensitive to delay or loss than others.
- Much of the focus in the network neutrality debate has been on prioritisation within the network; however, nearly the same effect can be achieved by Content Delivery Networks (CDNs) and other forms of caching, and by cloud services and other forms of replication. These alternative mechanisms for achieving differentiated Quality of Service have not raised significant network neutrality concerns, perhaps because most of the firms that provide them are not perceived as having incentives to practice harmful discrimination.
- The Internet is a complex interconnected system of networks. Most of these interconnections take place by means of variants of *peering* and *transit*.
- QoS within ISP networks is commonplace, and has been for years, but QoS-aware peering continues to be extremely rare.
- The Internet has experienced peering disputes from time to time over the past fifteen or twenty years. Nearly all have been between a content-heavy ISP that sends a great deal of traffic, and an 'eyeball'-heavy ISP that receives a great deal of traffic.
- These disputes are a function of the default 'shortest exit' routing used in the Internet. The use of alternative routing schemes and/or caching and CDNs could potentially serve to ameliorate the tensions that cause these conflicts.
- It is sometimes claimed that the differentiated QoS somehow violates core principles of the Internet (such as the end to end principle). In fact, differentiated QoS was always a design consideration for the Internet (although not fully implemented). Its rich history goes back decades, to the earliest days of the Internet and its predecessor networks.

In the traditional fixed voice telephone network, there was little concern about network neutrality; either a call completed (with better quality or worse), or it did not. Network operators and their customers typically had a common interest in achieving the best possible voice quality at a given cost and price. For an incumbent with Significant Market

Power (SMP) to wilfully block a call to a competitor's service or customer would in any case typically have been actionable by the national regulatory authority (NRA).

In the world of the Internet, many forms of wilful interference are possible, ranging from subtle degradation to outright blockage. Some are obvious, but others are difficult to detect.

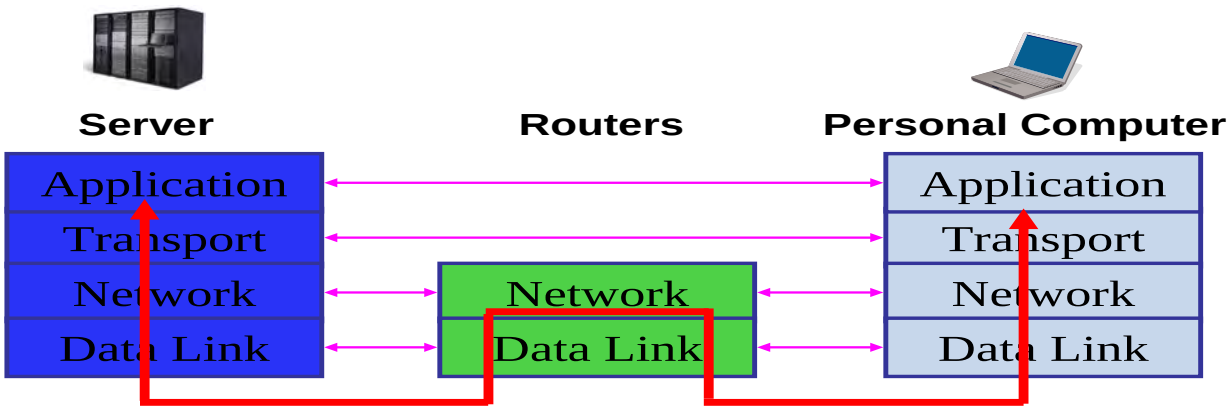
2.1. The Internet Protocol (IP) suite

The Internet is based on a suite of technical standards collectively known as the *Internet Protocol (IP)* or the *TCP/IP* (see below) family or *protocol suite*. Traditional communications networks use *circuit switching*, where a (virtual) circuit remained in place from the time that a call was initiated (dialled) until the call was completed. The circuit delivers information as a steady and (ideally) reliable sequenced stream. The Internet Protocol instead uses *packet switching*, where large streams of data are broken up into small *packets* of data, and each packet (or *IP datagram*) is independently directed (*routed*) to its end destination. An IP network does not inherently guarantee that all packets are delivered, nor that they are delivered in order; however, reliable in-sequence delivery services can easily be layered on top (notably by the *Transmission Control Protocol [TCP]*) for those applications that require it. IP-based packet switching has shown itself to be more flexible and more efficient than traditional circuit switching for a very wide range of uses.

The IP protocol suite is constructed as a *layered network architecture*, such that different layers of the network communicate with their peer layers in other devices, but need not know the details of layers above or below.

The application – which might represent browsing the web, or Voice over IP, or IPTV (television over the Internet) – *uses* the layers below, but need not concern itself with how those layers work. The *Data Link Layer* manages the underlying transmission device – which could just as well be a wireless mobile data service, a home or public Wi-Fi service, or a high speed Fibre to the Home (FTTH) service. The *Internet Protocol* itself comprises the *Network Layer*, which is responsible for forwarding traffic from one end of the connection to the other, usually through multiple *routers* (IP packet forwarding devices). It is the Transport Layer (notably, the Transmission Control Protocol) that is responsible for building reliable communications (if needed) out of the more primitive packet-based services available to it.

Figure 2: The Internet protocol architecture



Source: Marcus

The Internet Protocol (*IP*, which constitutes the Network Layer) delivers packets / datagrams on a 'best efforts' basis, without a guarantee of delivery, *in all cases.*[29] At the Transport Layer, the application can choose to use either the *User Datagram Protocol* (*UDP*),[30] which provides a direct use of IP facilities (making it possible, however, for the application to layer its own reliability or security on top of these primitive capabilities if desired), or the *Transmission Control Protocol* (*TCP*),[31] which builds a reliable virtual circuit by providing acknowledgments for the data that has been sent, and retransmitting if a timely acknowledgment has not been received.

Voice over IP (VoIP) applications often use UDP capabilities; streaming video applications more often use TCP.[32]

2.2. Quality of Service (QoS) in an IP-based packet network

Quality of Service (QoS) in an IP-based packet network is more complex than in traditional networks. IP networks are not designed to be able to carry all of every IP packet (or *datagram*) that every user might attempt to send or receive; rather, they are designed so that excess packets must wait until capacity is available. If more packets are waiting than can be stored, the excess packets must be discarded – this usually causes no harm, because the network protocols (notably TCP) typically ensure that missing packets are retransmitted. Discarding of packets under these circumstances does not denote a failure – it is a part of the normal functioning of the network.

This approach works extremely well for applications such as e-mail or file sharing, where small delays are perfectly acceptable. It is less well suited to real-time applications such as Voice over IP (VoIP), as we explain shortly.

In an IP network, every IP packet (datagram) goes through many point-to-point 'hops' from its starting point to its destination. Each hop contributes to the total time (*delay*) that it takes to traverse the network. Key performance parameters for each hop of an IP-based network include:

- **Bandwidth:** the maximum number of bits that a transmission path can carry.
- **Propagation delay:** The time that a packet requires, as a function of the combined length of all transmission paths and the speed of light through the transmission path.
- **Queuing delay:** The time that a packet *waits* before being transmitted. Both the *average delay* and *variability of delay (jitter)* matter, since the two together establish a confidence interval for the time within which a packet can be expected to arrive at its destination.
- **Packet loss:** The probability that a packet never reaches its destination. This could be due to transmission errors, but errors are quite rare in modern fibre-based fixed networks. More often, packets are lost because the number of packets waiting for transmission is greater than the available storage capacity (*buffers*).

[29] IETF (1981), Internet Protocol, RFC 791.

[30] IETF (1980), User Datagram Protocol, RFC 768.

[31] IETF (1981), Transmission Control Protocol, RFC 793.

[32] See, for instance, Vijay Kumar Adhikari, Yang Guo, Fang Hao, Matteo Varvello, Volker Hilt, Moritz Steiner and Zhi-Li Zhang (2012), 'Unreeling Netflix: Understanding and Improving Multi-CDN Movie Delivery': 'Netflix uses the DASH (Dynamic Streaming over HTTP) protocol for streaming. In DASH, each video is encoded at several different quality levels, and is divided into small 'chunks' - video segments of no more than a few seconds in length. The client requests one video chunk at a time via HTTP.'

Not every application is heavily dependent on the QoS. E-mail is, as previously noted, tolerant of high delay or loss, since users do not expect instant delivery. Real-time Voice over IP (VoIP), however, is very sensitive to delay, as we explain in Section 2.3.

If the application has specific requirements in terms of throughput, speed, or reliability, it can signal those to the Transport Layer (whether UDP or TCP), which could then pass the request through to the Network Layer. This could then be reflected in the Type of Service (ToS) field of each IP packet, which would potentially make the request visible to every router in the path, and as well as to end systems on both sides of the exchange. The notion of distinct Types of Service is thus a basic part of the protocol design; however, no system is obliged to honour the request, and the IP protocol design does not specify what, if anything, should be done with each request.

Queuing delay and packet loss are dependent on the amount of traffic that attempts to enter one hop of the network, in comparison to the amount of traffic that it can accommodate. *Queuing theory*, a branch of mathematics that deals with waiting lines, can be used to analyse these characteristics (see also Section 2.6).[33]

Box 1: Food for thought - Visualising delay in an IP network

From the perspective of the mathematics of queuing theory, a waiting line for an IP 'hop' is not very different from a waiting line for a ski lift. The waiting time is a function of the average number of skiers who show up per unit time, and the degree to which their arrivals occur in bursts, in comparison with the carrying capacity (think of *bandwidth*) of the lift. This delay is highly variable.

Once a skier has boarded the chair lift, the time to get to the top (think of *propagation delay)* is a function of speed of the lift, and of the distance to be traversed, but is independent of the number of skiers.

2.3. Relationship between network Quality of Service (QoS) and end user Quality of Experience (QoE)

The QoS parameters and mechanisms outlined in section 2.2 relate to the transport of packets at the Network (IP) Layer in the protocol stack (see Figure 2). These parameters and mechanisms are important to enable network operators to design, build and manage their networks; however, they are not directly visible to most consumer end-users. What counts for end-users is the quality that they personally experience during their use of services and applications. *The relationship between QoS at the IP network level and the end user Quality of Experience (QoE) is strongly dependent on the application.*[34, 35] Some important examples are:

- E-mail is, as previously noted, tolerant of high delay or loss, since users do not expect instant delivery.

[33] For a brief introduction to queueing theory, see Chapter 16 of J. Scott Marcus (1999), *Designing Wide Area Networks and Internetworks: A Practical Guide*, Addison Wesley Longman. For a comprehensive discussion, see Hisashi Kobayashi (1978), *Modeling and Analysis: An Introduction to System Performance Methodology*, Addison-Wesley.

[34] The QoE for the end user can also depend on factors other than the network QoS, such as the codecs used to code and decode voice and video at the application layer.

[35] Techniques for Measuring Quality of Experience, Kuipers, F.A., R.E. Kooij, D. De Vleeschauwer, and K. Brunnstrom, , Proc. of the 8th International Conference on Wired/Wireless Internet Communications (WWIC 2010), Lulea, Sweden, June 1-3, 2010, LCNS 6074, pp. 216-227, 2010.

- The QoE of voice conversations, such as in IP telephony, is dependent on packet delay, delay variation and packet loss. A well-known criterion is that for a proper experience, the one-way delay through the network should not exceed 150 milliseconds.[36] Longer delays may cause users on both sides of the connection to begin speaking at once (as with telephone conversations using geosynchronous satellites, where round trip delay is some 270 milliseconds).
- For interactive gaming, delay and delay variation are also important, especially for so-called first person shooter games.
- The parameters that determine the QoE for streaming video include not only those for voice conversation (i.e., delay, delay variation (jitter), and packet loss), but other parameters as well. For users watching video content in a classical TV environment with a defined set of channels to choose from through a remote control, the so-called *zapping time* is important. This is the time that elapses between the selection of a new channel on the remote control and the actual appearance of the new channel on the screen.

A key question relative to the network neutrality debate relates to the fraction of Internet traffic that requires explicit QoE management. It turns out that video is an inherently high bandwidth service, while VoIP is an inherently low bandwidth service.

Video over the Internet represents a large and increasing fraction of all Internet traffic (see Figure 3). Taking into account a range of applications, including traffic that remains on a single IP network, Cisco estimates that IP video traffic will account for 79 percent of traffic by 2018, and that the sum of all forms of IP video (including Internet video, IP VoD, video files exchanged through file sharing, video-streamed gaming, and videoconferencing) will continue to represent something in the range of 80 to 90 percent of total IP traffic.[37]

At the same time, a fairly small fraction of all video requires explicit QoE management. Streamed video on demand such as that provide by YouTube or Netflix usually performs adequately with or without the assistance of special prioritisation, as long as the traffic is not intentionally delayed.[38]

By contrast, the same well-respected *Virtual Network Index (VNI)* forecasts by Cisco systems have shown over many years that VoIP represents, and will continue to represent, a negligible fraction of total Internet traffic. At the time of our 2011 study for the Parliament, VoIP traffic was so small as to barely be visible on a bar chart;[39] in current Cisco forecasts, it is so small that it no longer makes sense to separately record it (see Figure 3).[40]

[36] ITU-T G.114 General Recommendations on the transmission quality for an entire international telephone connection (05/2003).

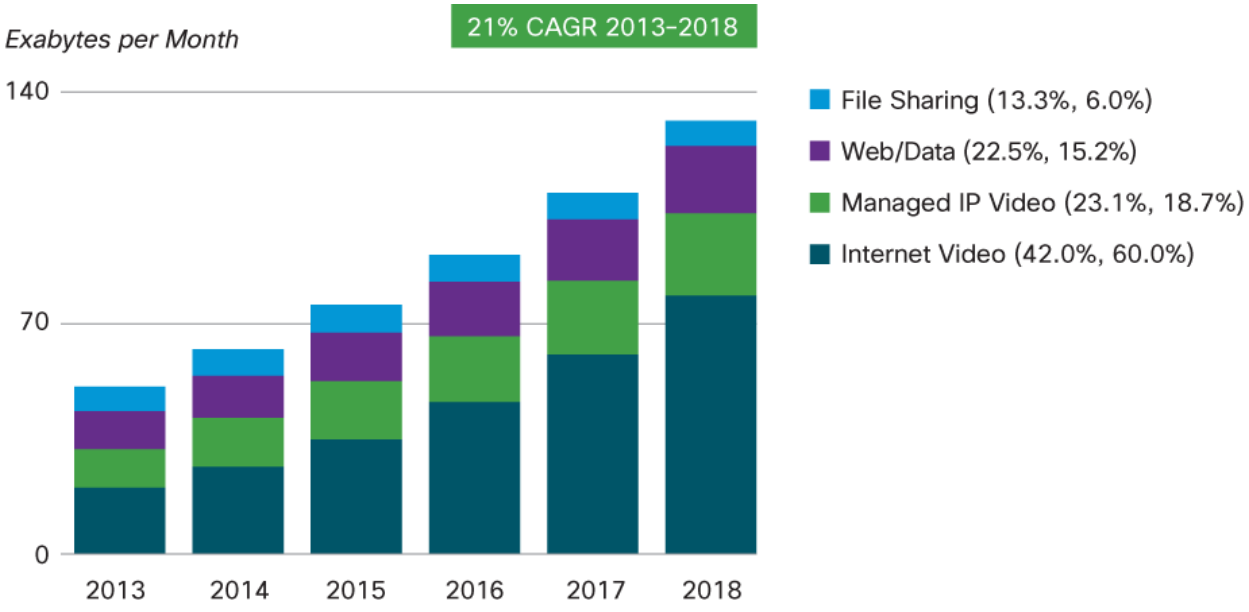
[37] Cisco (2014), The Zettabyte Era: Trends and Analysis, 10 June 2014.

[38] For streamed video (such as YouTube) where the user can tolerate a second or two of delay at the outset (i.e. where the permissible zapping time is large), the *receiving end system* can do a great deal to provide a suitable QoE by means of a *jitter buffer*. This is not purely a matter of the underlying *network*.

[39] Cisco (2010), Hyperconnectivity and the Approaching Zettabyte Era, 2 June 2010.

[40] Cisco (2014), The Zettabyte Era: Trends and Analysis, 10 June 2014.

Figure 3: Cisco forecast of European traffic by application type (2013 to 2018)



Source: Cisco VNI, 2014
The percentages within parentheses next to the legend denote the relative traffic shares in 2013 and 2018, respectively.

Source: Cisco VNI (2014).[41]

2.4. Means of improving Quality of Experience (QoE)

Much of the discussion of traffic management has been in the context of *prioritisation* within the network, usually implemented both by ensuring that high priority IP packets / datagrams are moved to the head of the transmission queue within a router and by ensuring that delay-sensitive packets are not the ones that are dropped if the router has insufficient storage to buffer all of the packets that are waiting for transmission (with effects that we discuss in Section 2.6). The IP QoS characteristics can thus be tailored so as to achieve the QoE requirements of the specific service (see Section 2.3).

Some have expressed concerns that the provision of different QoS to different applications may not accord with the so-called *end-to-end principle*. We do not agree. We return to this point in Section 2.6.

It is often forgotten that effects similar to prioritisation can be achieved by *caching* (storing frequently used static data close to the user) and by *replication* (where the same dynamically generated results can be produced in more than location in the network – cloud services are an example of this kind of distribution or replication of function).

A constellation of server computers used to implement caching and related functions is referred to as a *Content Delivery Network* (*CDN*).[42] Network operators can operate CDNs, but CDNs can just as well be operated by content providers (as is the case with Google and Netflix) or by third parties (such as Akamai). A CDN is not a transmission network, but it depends on transmission capabilities provided by the network operators, and generally is housed in locations leased from or otherwise provided by the network operators.

A prime example of caching is the distribution of streaming video through CDNs. Copies of popular videos are placed on video servers at many locations with good Internet

[41] Ibid.

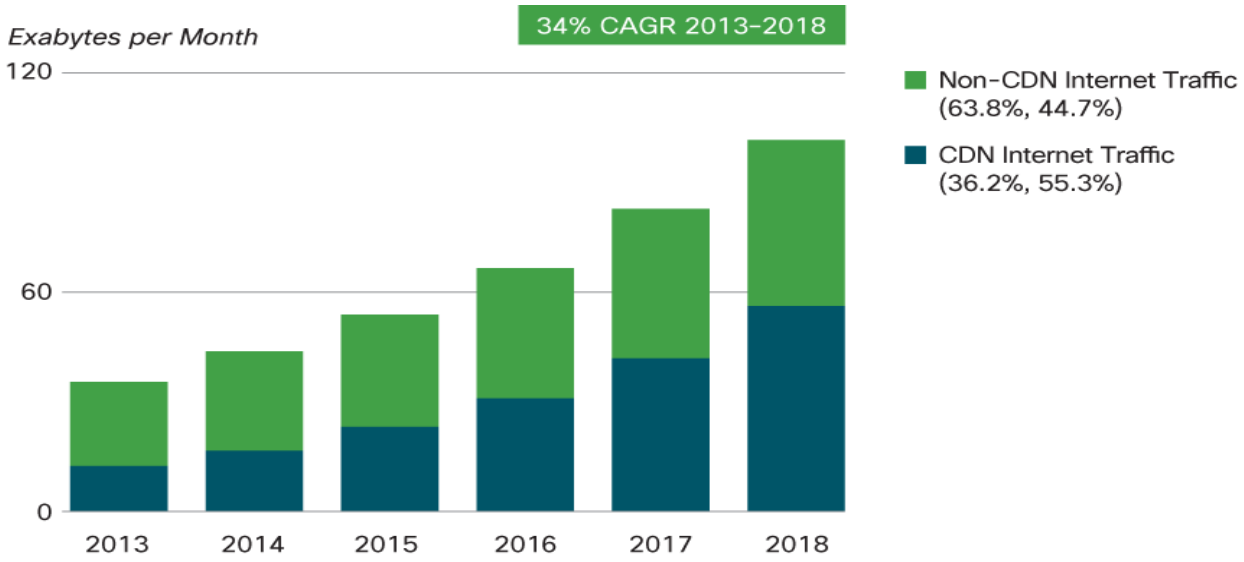
[42] Gries, C. and I. Philbeck (2013): Marktentwicklung im Bereich Content Delivery Networks (Market developments in Content Delivery Networks), WIK-Diskussionsbeitrag No. 376, April 2013.

connectivity and close to the interested audience, either within transmission networks or else at selected Internet Exchanges. By playing out the video from a server closer to the end users, the IP transport chain is shortened, potentially resulting in better IP QoS characteristics and hence a better QoE.

Cisco has observed that '… [w]hile network performance is usually attributed to the speeds and latencies offered by the service provider, the delivery algorithms used by content delivery networks have an equal if not more significant bearing on video quality.'

The use of CDNs has been steadily growing, and is predicted to continue to grow, partly as a result of the growth of video traffic over the Internet (which tends to be well suited to caching). Cisco anticipates that the majority of traffic (some 55%) will be carried by CDNs by 2018 (see Figure 4).

Figure 4: Content Delivery Network Internet Traffic (2013 to 2018)



Source: Cisco (2014), VNI.

It is worth noting at this point that CDNs achieve nearly the same effect as network prioritisation, but they have not raised comparable network neutrality concerns, presumably because most of the operators of CDNs are not perceived as having a commercial interest in favouring one kind of content over another.

2.5. The interconnection of IP-based networks

The Internet is the collection of network operators, or Internet Service Providers (ISPs), that comprise it. Many would define the Internet to also include every IP-based end user system that is attached to it, thus including laptop computers, smart phones, and a wide range of intelligent devices that primarily communicate with other devices.

For an end to end communication in the Internet to proceed entirely within a single ISP's network is the exception rather than the rule. More often, communication takes place between networks – often, between a great many networks.

Interconnection among ISPs is complex and continues to evolve, but the great majority of interconnections take place using one of two mechanisms: peering and transit. The clearest definition of these forms of interconnection comes from the NRIC, an advisory panel to the US FCC:

> *'Peering is an agreement between ISPs to carry traffic for each other and for their respective customers. Peering does not include the obligation to carry traffic to third parties. Peering is usually a bilateral business and technical arrangement, where two providers agree to accept traffic from one another, and from one another's customers (and thus from their customers' customers). …*
>
> *Transit is usually a bilateral business and technical arrangement, where one provider (the transit provider) agrees to carry traffic to third parties on behalf of another provider or an end user (the customer). In most cases, the transit provider carries traffic … to and from every destination on the Internet, as part of the transit arrangement.*
>
> *Peering thus offers a provider access only to a single provider's customers. Transit, by contrast, usually provides access at a predictable price to the entire Internet. Historically, peering has often been done on a bill-and-keep basis, without cash payments'.*[43]

Peering represents traffic exchange between an ISP's customers, and customers of their customers (who could also be ISPs), with the customers of another ISP. This implies that Internet traffic generally traverses at most one peering connection on its journey from source to destination. There must then be a complete chain of transit relationships between the eventual source and destination end user systems and the two peering systems.

With these two basic building blocks, the Internet can provide connectivity to the entire IP-based world.

In a transit relationship, the transit provider maybe offer QoS assurance to its customers – at least, it may offer guarantees up to the edge of its own network. The transit customer, however, typically provides no assurance to the transit provider.

In peering relationships, there have been efforts for years to provide quality guarantees between the peers. There are numerous practical impediments – for instance, two networks who compete head to head for the same end user customers are unlikely to be happy about sharing information about how well their respective networks are performing, and yet this is exactly what is required to make QoS guarantees enforceable. Further, QoS assurances would be of little value until and unless a group of providers who collectively represented a substantial fraction of the total Internet were fully on board. The economic transaction costs of gaining such a large consensus have so far proven insurmountable.

Thus, QoS controls are readily implementable within an ISP network, but there are few examples of QoS being offered on an end to end basis across multiple ISP networks.[44]

Network neutrality regulation might make such agreements difficult or impossible today, but agreements were also rare to non-existent fifteen years ago, when QoS-aware IP interconnection was already technically feasible and no regulatory impediments existed.[45]

---

[43] NRIC V, Focus Group 4 (2001), *Interoperability: Service Provider Interconnection for Internet Protocol Best Effort Service*. Note that these definitions incorporate both paid and unpaid peering, and partial and global transit; however, they omit a few exotic forms of interconnection such as reciprocal transit.

[44] See J. Scott Marcus, Dieter Elixmann, Kenneth R. Carter, and senior experts Scott Bradner, Klaus Hackbarth, Bruno Jullien, Gabriele Kulenkampff, Karl-Heinz Neumann, Antonio Portilla, Patrick Rey, and Ingo Vogelsang, *The Future of IP Interconnection: Technical, Economic, and Public Policy Aspects*, March 2008, a study prepared for the European Commission, available at: http://ec.europa.eu/information_society/policy/ecomm/doc/library/ext_studies/future_ip_intercon/ip_interconn_study_final.pdf.

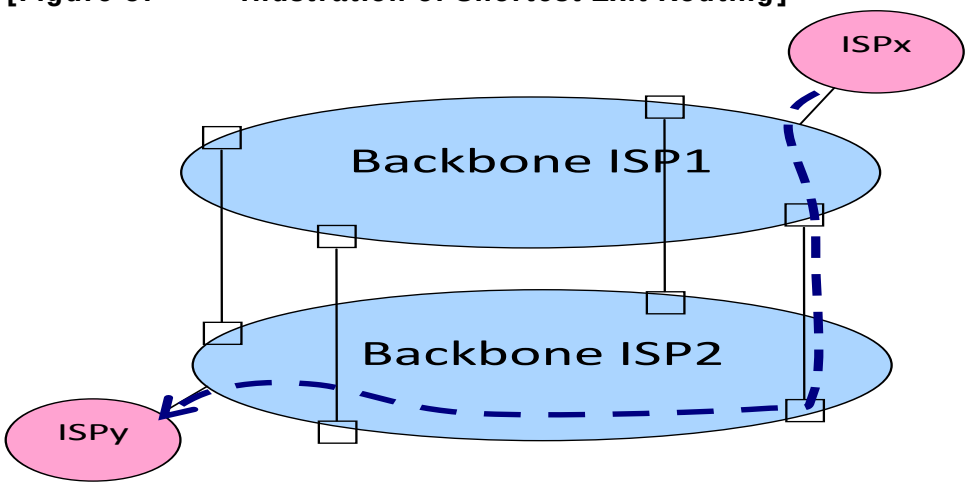
[45] This author was a central player in attempts to negotiate such arrangements among US backbones.

Peering arrangements are typically agreed amicably between the networks that engage in peering. Small networks often do not even bother with a contract.[46] Disputes between networks that are heavy in content and those that are heavy in consumers ('eyeballs') have, however, taken place from time to time over the past twenty years. The historical reasons for these disputes were linked to fundamental economic aspects of Internet *shortest exit* peering. They are significantly different from the *termination monopoly* issues encountered with voice telephony, which are linked to control over the telephone number.[47]

NRIC V, an advisory panel to the US FCC, provided a lengthy, detailed explanation.[48] Since that report is not widely available today, the discussion is reproduced in full here.

> *'In many cases, ISPs use shortest exit routing (also known as 'hot potato' routing). With shortest exit routing, a packet which is to be forwarded via a neighboring ISP is sent via the nearest interconnect to that ISP, without concern for where in the neighboring ISP the destination is actually connected. In other words, the packet will use the interconnect closest to the point where the packet enters the first ISP.*
>
> *Consider two ISPs which span the same geographic area, and which are interconnected in multiple locations. [Figure 5] shows an example of two backbone ISPs, which are interconnected in four locations.*

[Figure 5: Illustration of Shortest Exit Routing]



[**Source:** NRIC V, Focus Group 4 (2001), 'Interoperability: Service Provider Interconnection for Internet Protocol Best Effort Service'.]

> *Consider a packet originating in service provider ISPx (served by Backbone ISP1), for a destination in service provider ISPy (served by Backbone ISP2). ISPx forwards the packet to its backbone service provider, which is ISP1. ISP1 then does a normal route lookup, and finds that the destination is served by Backbone ISP2. ISP1 then forwards the packet to ISP2. With shortest exit routing, ISP1 will use*

[46] Dennis Weller and Bill Woodcock (2012), Internet Traffic Exchange: Market Developments and Policy Challenges, OECD.

[47] See J. Scott Marcus et al. (2008), 'The Future of IP Interconnection: Technical, Economic, and Public Policy Aspects', op. cit.

[48] NRIC V, Focus Group 4 (2001), *Interoperability: Service Provider Interconnection for Internet Protocol Best Effort Service*. This author was among the drafters of that report. See also J. Scott Marcus (1999), *Designing Wide Area Networks and Internetworks: A Practical Guide*, Addison Wesley.

the closest connection to ISP2, as illustrated in [Figure 5]. ISP2 then forwards the packet on to ISPy.

In this example, the ISP whose customer is originating the packet (ISP1) needs to forward the packet for only a short distance. The ISP whose customer is receiving the packet needs to forward the packet for a greater distance. This is a common occurrence when shortest exit routing is used.

If both ISPs use shortest exit routing, the paths that the packets take will not be the same in both directions, even between the same two end points.

[Asymmetries of traffic therefore come into play.] … A significant percentage of the traffic in the Internet goes between web users (i.e., personal computers and workstations) and web servers. In general, the volume of traffic from web user to web server is relatively small (consisting of requests for content), and the volume of traffic from web server to web user is relatively large (consisting of the content itself).

This implies that in many cases a particular user of the Internet may originate an exchange of data, for example by using their personal computer or workstation to query a web server. However, the system which initiates the exchange is typically the source of only a small percentage of the total traffic, while the web server which is offering a service is typically the source of the bulk of the traffic.

Where shortest exit routing is used between ISPs with a similar geographic footprint, this means that the amount of traffic is different in each direction, which may cause one ISP to incur more cost than the other.

In general, some ISPs may be primarily offering services to residential customers, others may primarily offer services to web servers, others may primarily offer services to business, while still other ISPs may offer services to a mix of customers. An ISP's customer ratio will have an effect on the symmetry or asymmetry of its traffic flows'.

It is this perceived asymmetry of costs that originally motivated implementation of traffic ratio requirements among large, US-based backbone ISPs during the late nineties. Many networks would provide settlement-free peering (i.e. peering without payment) only to ISPs that maintained a traffic ratio inbound and outbound to them that was less than some fixed constant such as 2.0.[49]

For traffic exchanged using shortest exit routing, the same considerations would arguably apply today; however, shortest exit routing is likely applicable to a declining fraction of Internet traffic. There are several reasons why this might be so.

- An increasing share of traffic, especially streamed video traffic, is cached close to the user. This traffic typically does not traverse a peering connection at all.[50] Largely

[49] This author created one of the first published peering policies during his time as CTO of GTE Internetworking, one of the largest global backbone ISPs in the world at the time.

[50] The traffic to populate and update the cache is likely to traverse a peering point, but this is usually a much, much smaller volume of traffic.

as a result, Cisco estimates that the ratio between local traffic (which typically does not leave a single network) and long-haul traffic between networks is likely to increase from 2.0 in 2013 to 2.6 in 2018.[51]

- Some Application and Content Providers (notably Google) offer to provide cache servers to ISPs at their own expense.
- Some Application and Content Providers intentionally attempt to route traffic so as to carry it closer to the preferred location within the destination network. For this to be effective, the ISP receiving the traffic needs to provide hints as to which interconnection point is to be preferred for traffic destined for specific IP addresses, and the sending network needs to honour the hint.[52] Doing so transfers much of the cost associated with asymmetric from the receiving network to the sending network.

2.6. The mathematics of prioritisation

The mathematics of prioritised service delivery have been well established in the literature for decades, but they are not well known to most of those who participate in the network neutrality debate. The mathematics is demanding.

One strand of the literature is scheduling theory, which is relevant not only to the scheduling of industrial processes, but also to the scheduling of activities within a computer system. The classic text is Conway, Maxwell and Miller (1967).[53]

The second relevant literature strand is queueing theory, the mathematics of waiting lines. Queuing theory is equally relevant to customers waiting to pay for their goods in a retail establishment, and to IP packets / datagrams waiting for service in a router.[54]

There is also an intersection with the economics literature, as we explain in Section 3.5.

Over the longer term, the network designer should design enough capacity into the network to carry the offered load at reasonable performance. In the short term, however, the network designer has only limited tools at his or her disposal with which to manage either long term shortfalls or short term 'spikes' in traffic.[55] The network is in place, and the transmission links have whatever capacity they have. Controlling QoS does not make the transmission links any faster; however, network designers and engineers can control:

- the relative priority with which each router processes the IP packets / datagrams waiting to be sent over each transmission link; and
- during periods where more packets are waiting than a given router is able to store or buffer, *which* packets are to be dropped.

Of the two, prioritisation is the easier to analyse and understand. Recall that each transmission link has whatever bandwidth capacity it has. Prioritisation does not change this. If some packets are moved forward on the waiting line, others are moved backward.

---

[51] Cisco VNI (2014), op. cit.

[52] This is typically done by means of Multiple Exit Discriminators. See Juniper Networks, 'Multiple Exit Discriminator', at: http://www.juniper.net/techpubs/software/junos-es/junos-es92/junos-es-swconfig-interfaces-and-routing/multiple-exit-discriminator.html.

[53] Richard Walter Conway, William L. Maxwell, Louis W. Miller (1967), Addison-Wesley. The text has been out of print for some time, but appears to be available as an e-book.

[54] See for instance Hisashi Kobayashi (1978), *Modeling and Analysis: An Introduction to System Performance Methodology*, Addison-Wesley, pages 209-211.

[55] Internet traffic can be highly variable in intensity. See, for instance, the discussion of traffic self-similarity on pages 62-63 of J. Scott Marcus (1999), *Designing Wide Area Networks and Internetworks: A Practical Guide*, Addison Wesley.

Consider a system with just two priorities, high and low. The magnitude of these effects depends on the relative number of packets in each class.

- If all packets were of high priority, or all of low priority, then prioritisation would have no effect whatsoever.
- If few packets were of high priority, and most were of low priority, then prioritisation would accelerate the small number of high priority packets by moving them to the head of the queue, but the low priority packets would experience only a small additional delay as a result.
- If most packets were of high priority, and few were of low priority, then prioritisation would *only slightly* accelerate the small number of high priority packets by moving them to the head of the queue (although the variability of delay would be reduced), but the low priority packets might experience substantial additional delay as a result.

The second of these cases corresponds to what one might expect if only VoIP datagrams were to be prioritised ahead of other traffic. VoIP is a low bandwidth service, but it is heavily dependent on the average and the variability of delay (see Section 2.3). Moving VoIP to the head of the waiting queue has little impact on other services, because the number of datagrams is small. This would appear to be an ideal case, where the consumer gains a much more effective and predictable use of VoIP, but with minimal negative impact on other applications.

Indeed, use of VoIP without prioritisation has often been found to be problematic, as we explain in Section 4.4.

The third case could be said to correspond to the delivery of linear television-like video (*IPTV*) to consumers over the Internet. A large volume of prioritised IPTV traffic is moved ahead of web traffic in the queue. In principle, this causes a large delay to the web traffic. In practice, this does not appear to generate consumer complaints. Network operators in a competitive market presumably have no incentive to make their customers unhappy, so they apparently limit the total level of IPTV traffic so as to ensure that web traffic also gets through. Given that IPTV traffic is a large but relatively steady stream of traffic, moving it forward on the queue does not introduce substantial incremental variability of delay (jitter) into the web traffic that has been delayed.

In cases where the offered load is greater than the capacity of the transmission medium, the queue of packets waiting to be transmitted will grow without bound. Sooner or later, the number of packets that can be stored (buffered) exceeds the storage available, and some must simply be thrown away. When this happens, it is not just a matter of setting priorities on the queue, but also of determining which packets get discarded (and eventually retransmitted).

2.7. Traffic prioritisation and the end-to-end principle

The Internet Protocol family was optimised from the first for applications that do not require special handling in terms of preference or prioritisation, and there are practical challenges in implementing prioritisation; however, prioritisation should not be viewed as violating the basic architecture of the Internet.

In the Internet, applications communicate conceptually with one another on an end to end basis. (The path from one router to another router, or from a router to an end point such as the server or personal computer shown in the figure, are *point to point* rather than *end to end*.) It was recognised from the first that many functions are best accomplished by the

applications themselves on an *end to end* basis.[56] Some have interpreted this *end to end principle* as a core tenet of the Internet,[57] and have argued that an extreme form of network neutrality with no prioritisation at all is required in order to adhere to it; however, this is probably giving the principle much too much weight. In reality, the end to end principle was intended to merely reflect pragmatic engineering trade-offs that were relevant at the time.

Notably, some have argued that the Internet protocol suite intended from the first to treat all traffic alike, without preference or prioritisation. This is simply incorrect; prioritised delivery was always envisioned as part of the Internet Protocol (although details were not fully specified at the outset).[58] The implementation was entirely consistent with the layered network of the Internet – the application was to signal its Type of Service requirements to the transport layer, just as it would signal any other functional requirement, and the (TCP or UDP) transport layer would in turn signal the Type of Service requirement to the Internet Protocol (IP) network layer. Work on prioritised traffic delivery over Internet Protocol has a rich tradition with roots going back to the earliest days of the Internet and its precursor networks in the seventies, eighties (when production QoS-aware systems were in place for the US military)[59] and nineties (when most US-based Internet backbone ISPs had already implemented QoS capabilities into their networks).[60]

[56] Saltzer, J., Reed, D., and Clark, D.D. End-to-End Arguments in System Design. Second International Conference on Distributed Computing Systems, pages 509-512, April 1981. ACM Transactions on Computer Systems, 2(4), pages 277-288, 1984.

[57] Cf. Isenberg, David (1 August 1996). 'The Rise of the Stupid Network', available at http://www.rageboy.com/stupidnet.html (viewed 10 April 2011).

[58] See RFC 791, 'Internet Protocol', September 1981, which defines version 4 of the Internet Protocol (IPv4): "The Type of Service provides an indication of the abstract parameters of the quality of service desired. These parameters are to be used to guide the selection of the actual service parameters when transmitting a datagram through a particular network. Several networks offer service precedence, which somehow treats high precedence traffic as more important than other traffic (generally by accepting only traffic above a certain precedence at time of high load). The major choice is a three way tradeoff between low-delay, high-reliability, and high-throughput." Internet Protocol version 6 (IPv6) carried forward the same principles, but expanded the number of bits available to encode the requested service quality.

[59] See for instance C. Topolcic, RFC 1190, Experimental Internet Stream Protocol, Version 2 (ST-II), 1990; and L. Delgrossi and L. Berger, RFC 1819, Internet Stream Protocol Version 2 (ST2), 1995.

[60] This author was the Chief Technology Officer (CTO) for one of the largest backbone ISPs, GTE Internetworking, in the late nineties. We and our major competitors already made use of QoS management capability in 1997.

3. ECONOMIC PRINCIPLES UNDERLYING QUALITY DIFFERENTIATION

KEY FINDINGS

- There are different economic views of network neutrality. Differences in quality and price in most circumstances are benign; however, some forms can be harmful.
- Quality differentiation is a well understood practice that, in the absence of anticompetitive discrimination, generally benefits both producers and consumers.
- When a producer with market power in one market segment attempts to project that market power into upstream or downstream segments that would otherwise be competitive, that constitutes economic foreclosure. Foreclosure harms consumers, and imposes an overall socio-economic deadweight loss on society.
- The Internet can be thought of as a two-sided platform, with network operators serving as a platform connecting providers of content (e.g. web sites) with consumers. Under this view, some disputes are simply about how costs and profits should be divided between the network operators and the two (or more) sides of the market. This is a relatively benign interpretation.
- The number of viewers/customers that one has can provide a special form of market power associated with network effects. Network effects interact with other economic aspects in complicated ways.
- Quite a bit of relevant work has been done by the economists over the past ten years. A number of apparently sound papers suggest that, for markets where competition is effective (presumably taking into account other regulation already in place), market based solutions are likely to be superior to imposed regulatory solutions (including an obligation not to charge for interconnection) because the regulatory solutions necessarily ignore market signals. Otherwise, the results are largely inconclusive – a great many factors influence whether network neutrality regulation is, on balance, positive or negative for societal welfare.

There are many different economic tools that can provide insights in the network neutrality debate. In this section, we discuss quality discrimination in general (Section 3.1), economic foreclosure (Section 3.2), two-sided markets (Section 3.3), and network effects (Section 3.4). Finally, we review some of the economic analysis of network neutrality that has appeared in recent years in Section 3.5.

3.1. Quality differentiation

Over the past twenty years, networks have been privatised and opened to competition. In a fully competitive environment, competitors might be tempted to lower prices in order to win business, the only lower limit to this process being the short run marginal cost of running the network; however, at that price level, there would be no way for the network operator to recoup the initial investment in the network, nor would there be incentive to maintain or improve the network.

Network operators could address this challenge in various ways, most notably by means of:

- **Ramsey-Boiteux pricing**, where the network operator takes a higher mark-up on services where the volume that the end-user purchases is not much dependent on the price (i.e. services that are relatively *inelastic*), and a lower mark-up on price-sensitive services;[61] and
- **Quality differentiation,** where the network operator offers different qualities of service at different prices. Quality differentiation can enable the network operator to maintain some pricing power.[62]

Both represent a departure from pure cost-oriented prices. Both can, under suitable conditions, enhance social welfare.

Network operators (like other firms) seek to differentiate their offerings in order to weaken the force of price competition. This differentiation may be accompanied by differentiated or non-linear pricing arrangements. Indeed, where customer preferences are heterogeneous, differentiated prices may be necessary for efficient outcomes.

Depending on the extent to which different users have distinct preferences for one aspect of service over another, this may have beneficial effects: covering the fixed costs of network infrastructures, increasing overall capacity (and thus reducing deadweight loss), and, where the quality differences align with differences in user preferences, achieving a better match between user needs and service levels. At the same time, they can also have negative impacts, including: spurious differentiation; excessive monopoly rents; distorted innovation (e.g. feature-based competition that does not deliver enhanced functionality); and collusive market-sharing arrangements.

We are all familiar with this principle in the context of airplane or railroad tickets: we do not consider it anticompetitive for airlines to offer economy, business and first class tickets. Moreover, we recognize instinctively that the differences in *price* are only weakly linked to differences in *cost*. French railroads ran the passenger cars for third class (their least expensive service) with wooden benches and without roofs in the Nineteenth Century 'not because of the few thousand francs which would have to be spent to put a roof over the third-class carriage or to upholster the third-class seats, [but rather to] prevent the passengers who can pay the second-class fare from travelling third class'.[63]

In competitive markets, this quality and price discrimination is generally welfare-enhancing. It serves to benefit both the producers and the consumers of a product or service.

Internet Service Providers (ISPs) can or could use quality and price differentiation in many different ways[64] and for many different purposes. Some of these are probably positive or neutral to societal welfare on balance, while others are not. Possible reasons to differentiate include:

- extracting more money from existing customers;

---

[61] Ramsey-Boiteux pricing depends, however, on a degree of pricing power. For an introduction to Ramsey-Boiteux pricing, see Laffont and Tirole (2001), *Competition in Telecommunications*. They note that a corporate monopolist and a benevolent social planner have similar incentives to reflect demand elasticity in pricing, and that doing so is efficient.

[62] See especially Harold Hotelling, 'Stability in Competition', *The Economic Journal*, March 1929, pages 41-57.

[63] 'Having refused the poor that which is necessary, they give the rich that which is superfluous.' Emile Dupuit, quoted in Andrew Odlyzko (2004): The evolution of price discrimination in transportation and its implications for the Internet, *Review of Network Economics*, vol. 3, no. 3, September 2004, pp. 323-346.

[64] Quality as experienced by Internet end-users could include not only capacity and delay, but also price, security, reliability, or ubiquity, while the ISPs and others along the value chain may not think of quality in the same way.

- attempting to extract money from content providers on the other side of the two-sided market (see Section 3.3);
- locking-in existing customers through personalised service;
- attracting rivals' customers;
- shifting high cost customers to rivals;
- getting customers to implicitly reveal private information/demand characteristics through their choice of plan or through changes in their service utilisation patterns;
- changing customer preferences;
- modifying consumer behaviour to reduce congestion and other negative spill-overs (e.g. by congestion charging).

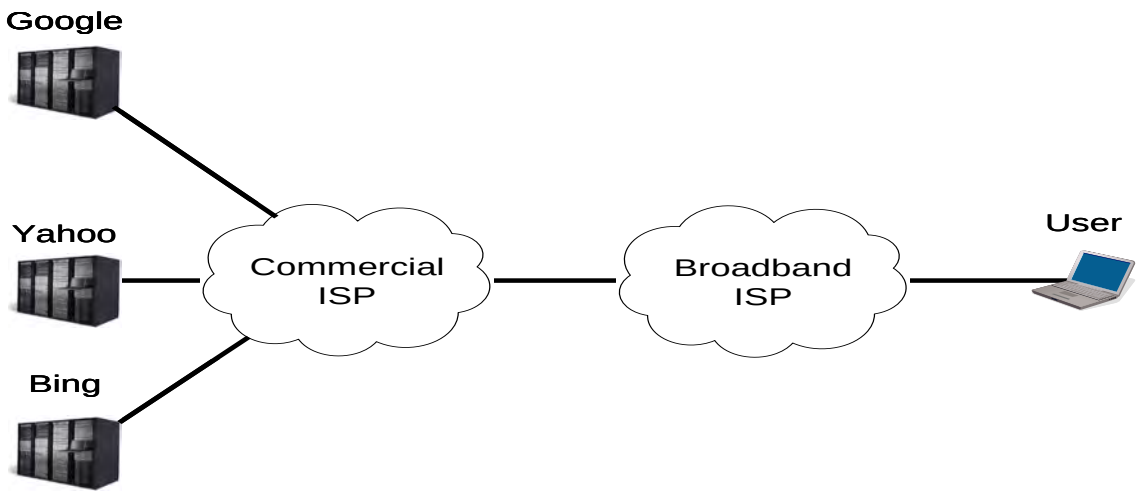
3.2. Economic foreclosure

A key concern regarding network neutrality has been with *economic foreclosure*. Foreclosure occurs when a firm that has market power in one segment attempts to project that market power into vertically related market segments where competition would otherwise lead to efficient outcomes.

It is perhaps useful to work through an example involving end-user access to search engines such as Google, Yahoo, or Bing. The search engine does not charge the end-user; instead, it monetises end-user attention by selling advertisements and preferential list placement to merchants. Each end-user can be assumed to choose his or her ISP (the *Broadband ISP* in Figure 6) independently, and to pay for that ISP to convey traffic throughout the Internet. Each Internet service or application provider (in this example, each search engine) also chooses one or more ISPs (the *Commercial ISP* in Figure 6) independently, and pays those ISPs to convey traffic throughout the Internet. There is no assurance that a given end-user's Broadband ISP will be the same firm as any of the Commercial ISPs employed by the end-user's preferred applications; nonetheless, the system works, and the traffic is conveyed between the service and the end-user.

The end-user has, in the normal course of events, a free choice among Internet search engines such as Google, Yahoo, and Bing (see Figure 6). Suppose, however, that the user's broadband ISP were acquired by (to pick an example) Google, or otherwise were to form some affiliation with Google. Might the broadband ISP then favour Google, to the detriment of competitors (Yahoo and Bing in this example), and to the detriment of consumer choice?

Figure 6: Application services, ISPs, and end-users



Source: WIK.

Whether this would be profitable for the broadband ISP depends on many factors. How strong is the desire of the end-user to access search engines other than Google? Could the end-user choose among other broadband ISPs, some of whom would not impose restrictions on access to Yahoo or Bing? Would the switching costs be prohibitive?

Box 2: Food for thought - The Madison River case

In March 2005, the US FCC announced that it had reached a settlement with a small local telephone company called Madison River over allegations that Madison River was blocking end-user access to VoIP applications. The FCC has never explained exactly what rules, if any, had been violated. Madison River nonetheless agreed to end the practice, and made a small 'voluntary' contribution of $15,000 to the US Treasury.

Madison River presumably felt that VoIP competed with its own traditional voice services. They had both the incentive and the ability to block VoIP, and apparently did so. This would appear to represent a clear cut instance of economic foreclosure.

If the user's desire to access other search engines is strong, and if competitive broadband providers are available, and if switching costs are low, then restricting access to Yahoo and Bing is likely to be unprofitable for the broadband ISP. Too many users would switch to competitors. The broadband ISP is unlikely to attempt an unprofitable strategy.

Conversely, if consumer choice among broadband ISPs is poor, or switching costs are high, or consumer preferences are not strong enough to promote switching, then the broadband ISP might be tempted to block or impair access to unaffiliated services.

Economic foreclosure generally *reduces societal welfare*. It not only transfers welfare from consumers to suppliers (in this case, the broadband ISP, and possibly also the affiliated search engine); to the extent that it results in increased prices and reduced consumer choice, it also reduces demand in the sense that it results in services that would have been consumed in a competitive market, but are not in the foreclosed market. This lost consumption represents a *deadweight loss* to society as a whole.[65]

Box 3: Food for thought - The Comcast - BitTorrent case

In November 2007, the US FCC received a complaint on behalf of Rob Topolski, a network engineer, amateur musician and broadband subscriber of Comcast (the largest US broadband ISP). Topolski had discovered to his surprise that no one was able to download his uncopyrighted music from BitTorrent.

According to the complaint, Comcast was actively interfering with Topolski's use of BitTorrent by masquerading as another computer and using reset packets to stop the transmission of files in various peer-to-peer networks, notably BitTorrent. The reset packets did not technically block the application, but delayed it sufficiently that it was effectively blocked.

The FCC ordered Comcast to precisely disclose its current and future network management practices, and to submit a compliance plan.

Was Comcast's behaviour inspired by the belief that use of peer to peer applications by its customers was interfering with its own ability to sell content? Or were other considerations paramount?

The subsequent litigation is discussed in Section 6.1.

[65] These relationships are often expressed in the form of *Harberger's Triangle*.

3.3. Two-sided markets

A relatively new branch of economics deals with two-sided markets.[66] In a two-sided market, a platform provider somehow benefits by bringing the sides of the market together. Payment could come from either side of the market; thus, relationships between price and cost that would be irrational in a conventional market might be reasonable in a two-sided market.

Broadcast television is a common and pertinent example. Payment comes from programmers/broadcasters, and ultimately from advertisers; the consumer typically pays little or nothing. In a conventional market, it would be strange for consumers to pay less than the cost of the service, but in a two-sided market it can be rational.

Cable television provides a more complex demonstration of the dynamics of two-sided (or multi-sided) markets. High value content providers such as premium sports can typically demand high payments from the cable operator, i.e. the provider of the two-sided platform; providers of content that is valued less, or that is valued by fewer end-users, may not be able to command high payments, or for that matter may need to pay the cable operator to have their content transmitted. The results of the negotiation are heavily dependent on the relative bargaining power of the parties. Payment may flow in some cases from the end-user to the content provider, typically through the cable operator. From an economic perspective, the fact that a bargaining game is involved is not necessarily a problem, nor is the relevance of bargaining power. The negotiated outcomes can be economically rational and efficient.

The two-sided (or multi-sided) cable television marketplace differs from that depicted in Figure 6 chiefly in that, instead of a single cable television platform, there are two or more ISPs involved (shown in the figure as Commercial ISP and Broadband ISP), and they are usually distinct firms (see also Section 3.5).[67, 68]

Box 4: Food for thought - The BBC iPlayer dispute

In December 2007, the BBC launched the *iPlayer*. The iPlayer is a peer-to-peer (P2)) application that allows subscribers to view recent programmes free of charge by streaming or downloading them to their computer. The success of the iPlayer drove significant demand for bandwidth, thus imposing significant cost on access ISP networks. Several ISPs expressed concerns, and some acknowledged engaging in traffic shaping techniques to manage network traffic by giving lower priority to users who download large files at peak times.

This is at its heart a two-sided market dispute. BBC actions led to the dispute, but the dispute could just as well be said to have originated with the end-user ISP customers who wished to view BBC content. Inevitably, the question was which side of the market should bear the substantial costs.

The BBC ultimately defused the dispute by content servers at various points in the BT network. The BBC is also developing a simple system to help make iPlayer users aware of the bandwidth that they are consuming.

---

[66] Rochet, Jean-Charles/ Tirole, Jean (2004): Two Sided Markets : An Overview, March 2004, available at: http://faculty.haas.berkeley.edu/hermalin/rochet_tirole.pdf.

[67] This is also noted in Rochet and Tirole (2004), op. cit.

[68] A comprehensive analysis of the situation, with web sites and consumers served by different ISPs, appears in Laffont, J.-J., Marcus, J.S., Rey, P., and Tirole, J., 'Internet interconnection and the off-net-cost pricing principle', *RAND Journal of Economics*, Vol. 34, No. 2, Summer 2003.

Network operators have often argued in recent years that they need to exploit the other side of the two sided market in order to cover exploding costs for bandwidth. It is perhaps worth noting that exploding bandwidth requirements are by no means a new phenomenon. Traffic growth rates in the fixed network today are far less in percentage terms than they were in the late nineties (although that percentage growth is on an immensely larger base today). A key question has always been whether technology-driven improvements in unit costs would work more quickly than the increase in traffic. With the decline in percentage traffic growth per year, one might hope that it is becoming easier, not harder, for fixed network operators to keep up with traffic growth.

3.4. Network effects

In many industries, there are advantages to having large number of customers that go far beyond pure economies of scale.[69] The postal system is worth more to you because it is possible to send a letter to practically anyone. In the same way, each time another user joins the Internet, the value to all users could be said to have increased.[70]

These same network effects can confer a form of market power on firms that control access to a large number of users. The economics of market power in industries subject to network externalities has been extensively analysed over the years,[71] especially in connection with standards compliance. More recently, the work was extended to consider the implications for interconnection, including Internet interconnection.[72] In general, where no player has a dominant market share (in overall percentage terms, and also relative to the next largest players) in terms of controlling access to customers, all players will be motivated to have good interoperability and interconnection. Where one player has a sufficiently large share, however, that player will be motivated to have less-than-perfect interoperability and/or interconnection, because perfect interconnection would prevent it from exploiting its market power.[73]

3.5. An evolving literature

Up to this point, the discussion in this chapter has focussed on general economic principles, and on general sector-independent economic literature. The general underlying economic principles have been understood for decades.

In recent years, driven by the public policy interest in network neutrality, an entire economic literature specific to the problem has cropped up. Sharkey and Bykowsky (2014b)[74] contains a good comparative summary of many of the most relevant papers. Based in large part on their assessment, some key observations that flow from the literature are:

---

[69] Rohlfs, Jeffrey H. (2003): *Bandwagon Effects in High Technology Industries*, MIT Press, 2003.

[70] This is, of course, not true for all potential users. Spammers, for instance, impose negative externalities that decrease the value of the Internet to other users.

[71] See M. Katz and C. Shapiro (1985), 'Network externalities, competition, and compatibility', *American Economic Review* 75, 424-440.; and J. Farrell and G. Saloner (1985), 'Standardization, compatibility and innovation', *RAND Journal of Economics* 16, 70-83.

[72] Jacques Cremer, Patrick Rey, and Jean Tirole, 'Connectivity in the Commercial Internet', May 1999.

[73] Ibid.

[74] Mark M. Bykowsky and William W. Sharkey (2014b), 'Welfare Effects of Paid for Prioritization Services: A Matching Model with Non-Uniform Quality of Service', available on SSRN.

- Where the Broadband ISP has no market power, a rule that prohibits a Broadband ISP from charging CASPs a competitive price for differentiated quality unambiguously reduces societal welfare.[75]
- Under more general assumptions, whether a rule that prevents price or quality discrimination enhances or reduces societal welfare depends on a great many factors and assumptions, such as:
    - Whether the value that Application or Content Providers place on an additional subscriber is greater than the value that subscribers place on an additional Application or Content Providers.[76]
    - Whether the Broadband ISP derives more revenue from end user subscribers than from Application or Content Providers.[77]
    - The level of the elasticity of demand with respect to transmission time on the part of end user consumers and of Application or Content Providers.[78]
    - The nature and intensity of Broadband ISP competition for end user consumers, and the degree to which payments required on the part of Application or Content Providers reduces their participation in the market.[79]
    - Whether the Broadband ISP is a monopoly provider that is able to extract all the surplus from the end user consumer side of the market.[80]

In general, and with the notable exception of Laffont et al. (2003) (better known as the LMRT paper), the literature focuses on quality and price discrimination among the user, the Broadband ISP, and the Application or Content Provider. The disintermediating role of the Commercial ISP is largely ignored (see Figure 7, which reflects the LMRT conceptual model), but likely represents a key reason why arrangements between Application or Content Providers (websites in the context of the LMRT analysis) and Broadband ISPs are so rare today. (By contrast, every Application or Content Provider either has a commercial arrangement with a Commercial ISP, or else functions as its own Commercial ISP.)

[75] Mark M. Bykowsky and William W. Sharkey (2014b), 'Net Neutrality and Market Power: Economic Welfare with Uniform Quality of Service', available on SSRN. Their analysis relates to a requirement that the charge be zero, but similar concerns would likely apply to setting the charge to any other fixed level – ignoring the market signals provided by the willingness to pay (WTP) of consumers of or content or application providers tends to imply a loss of efficiency. See also Bourreau, M., F. Kourandi and T. Valletti (2014), 'Net Neutrality with Competing Internet Platforms', CEIS Working Paper No. 307, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2395991.

[76] Economides, N., and Tag, J. (2012), 'Net Neutrality on the Internet: A Two Sided Market Analysis,' Information Economics and Policy, Vol. 24, pgs. 91-104.

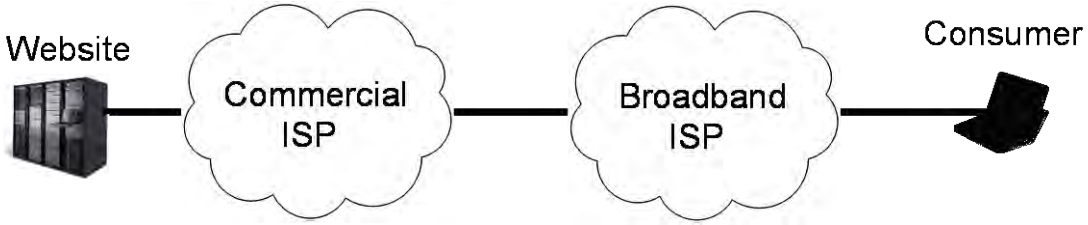
[77] Musacchio, J., G. Schwartz and J. Walrand (2009), "A Two-Sided Market Analysis of Provider Investment Incentives with and Application to the Net-neutrality Issue," Review of Network Economics, 8(1), pgs. 22-39.

[78] Economides, N. and Hermalin, B. (2012) "The Economics of Network Neutrality," Rand Journal of Economics, Vol. 41(4), pgs. 602-629.

[79] Njoroge, P., A. Ozdaglar, N.E. Stier-Moses and G.Y.Weintraub (2013), 'Investment in Two-Sided Markets and the Net Neutrality Debate', *Review of Network Economics*, Vol. 12(4), pg. 355-402.

[80] Jay Pil Choi, Doh-Shin Jeon, and Byung-Cheol Kim (2014), 'Net Neutrality, Business Models, and Internet Interconnection', available at http://www.econ.gatech.edu/files/papers/AEJMicro-2013-0162-Revision.pdf.

Figure 7: Websites, ISPs, and end user consumers



Source: Marcus

A key finding of LMRT is that payments between the Backbone ISP and the Commercial ISP would tend (in competitive markets) to be reflected in the prices ultimately paid to the ISPs by their respective customers. A positive access charge would reduce payments on the part of end user subscribers and increase it on the part of websites. In LMRT, we found that '… the access charge determines the allocation of communication costs between senders (mainly websites) and receivers (mainly consumers) and thus affects the level of traffic. The socially optimal access charge takes into account [not only] the demand elasticities on the two segments, but also the magnitude of the externality that each segment generates on the other segment.' LMRT also notes that if ISPs have market power, their interests are in general no longer aligned with social welfare.[81]

[81] Laffont, J.-J., Marcus, J.Scott, Rey, P., and Tirole, Jean (2003), J., 'Internet interconnection and the off-net-cost pricing principle', *RAND Journal of Economics*, Vol. 34, No. 2, Summer 2003.

4. PUBLIC POLICY PRINCIPLES UNDERLYING QUALITY DIFFERENTIATION

KEY ISSUES

- To an economist, *quality differentiation* and *quality discrimination* are roughly synonymous; however, we have largely avoided the term *discrimination* in this report because the word carries negative connotations.
- Prioritisation is not *per se* deleterious. Under many circumstances, prioritisation benefits all concerned.
- We would argue that any specific measures related to network neutrality need to be carefully and narrowly targeted so as not to interfere with societally beneficial uses of the same instruments.
- Network neutrality could be viewed as generating three dimensions of conflicts: (1) vertical conflicts, (2) horizontal conflicts, and (3) diagonal conflicts.
- The recent Netflix Comcast dispute (and subsequent agreement) can be viewed as a diagonal conflict. It can be viewed as reflecting a complicated mix of multiple elements already discussed, including (1) a classic peering dispute, (2) vertical foreclosure, and (3) a two-sided market accommodation.
- In Commission public consultations and BEREC Common Positions over the years, a consistent theme is that there have been very few instances of harmful discrimination. One possibly worrisome area that stands out as an exception relates to VoIP, especially in mobile devices; this, however, could perhaps be addressed with narrowly targeted remedies.
- Services including VoIP, videoconferencing, certain forms of gaming, and mission critical services such as Public Protection and Disaster Relief (PPDR) and transport could potentially benefit from traffic management.
- The NRAs have repeatedly stated through BEREC that they believe that they already have sufficient powers to address any network neutrality issues that might arise.
- One recent study raises possibly legitimate concerns about the effectiveness of existing European remedies. Given the scarcity of problematic incidents, this may or may not be a concern.
- Concerns that network operators would choose to offer prioritised and/or specialised services in such a way as to make non-prioritised services unattractive or unusable seem to us to be speculative or overblown. Similarly, concerns that the most successful content and application providers would use quality differentiation to crowd out smaller competitors seem to us to be speculative or overblown.
- Threats to freedom of expression are a serious concern worldwide, but do not seem to require special network neutrality measures within Europe.

In this chapter, we provide background on the public policy themes that are relevant to network neutrality. We note that quality differentiation is not necessarily the same thing as harmful discrimination. We provide a hopefully useful distinction between horizontal, vertical and diagonal effects, and provide an example of the last of these. We summarise the harms identified to date in Europe, and provide for balance a few remarks about the benefits of quality differentiation in Europe. We consider the measures already available or in place in Europe, and note concerns that have been raised as to how effective they would be if truly needed. Finally, we touch on other network neutrality concerns that have been raised, including freedom of expression.

4.1. Differentiation or discrimination?

As noted in Section 3.1, to an economist, *quality differentiation* and *quality discrimination* are roughly synonymous. Throughout this report, however, we have sought to avoid the term *discrimination* because the word carries negative connotations.

Analogously, to an Internet engineer, a Type of Service is essentially just a number, as we explained in Section 2.6.

Prioritisation is not *per se* deleterious. As we have noted throughout, under most circumstances, prioritisation can benefit all concerned, i.e. can lead to a *Pareto improvement*.[82]

As we noted in Section 3.2, however, prioritisation or blocking could be harmful to societal welfare where a party that has market power seeks to project that market power into otherwise competitive upstream or downstream markets (*vertical foreclosure*). Blocking could intrude on freedom of expression. Other harms cannot be excluded.

This is a crucial issue, but perhaps difficult to grasp. Quality differentiation *per se* is not harmful, but it can be used in harmful ways.

A simple analogy may help.[83] Knives have many uses, some of which are clearly harmful. They can be used to injure or kill people. They also have numerous positive uses. Whether a particular use of a knife is good or bad depends entirely on the context and on the user's intent. A criminal using a knife to threaten someone in order to rob him is a rather different case from that of a soldier in wartime, which is different again from a knife's use by a gourmet chef.

A blanket prohibition on the use of knives would clearly be ill-advised. It would make our European kitchens the poorer.

Certain actions that can be conducted using a knife are generally illegal, such as assault, battery, and murder. It is not the knife itself that is prohibited, but rather the harmful action that is taken using it.

Many jurisdictions also restrict the production, importation and/or sale of certain kinds of knives that have few if any positive uses, such as switchblades. Measures along these lines need to be carefully crafted so as to impact as little as possible the non-harmful uses of the same implement.

We would argue on analogous grounds that any specific measures related to network neutrality need to be carefully and narrowly targeted so as not to interfere with societally beneficial uses of the same instruments.

---

[82] In a *Pareto improvement*, a change benefits some parties and injures no one.

[83] We suggest this with caution, noting that analogies are never perfect, and can sometimes confuse the issue.

4.2. A taxonomy for analysis: vertical, horizontal, and diagonal effects

The literature on network neutrality has struggled to characterise and categorise the many different aspects of the problem. In this section, we offer some classifications in an effort to more clearly describe and categorise network neutrality issues.

Network neutrality could be viewed as generating three dimensions of conflicts for public policy: (1) vertical conflicts, (2) horizontal conflicts, and (3) diagonal conflicts (see Figure 8).[84] In this section, we generally follow the nomenclature used in Sections 3.3 and 3.5, and reflected in Figure 6 and Figure 7.

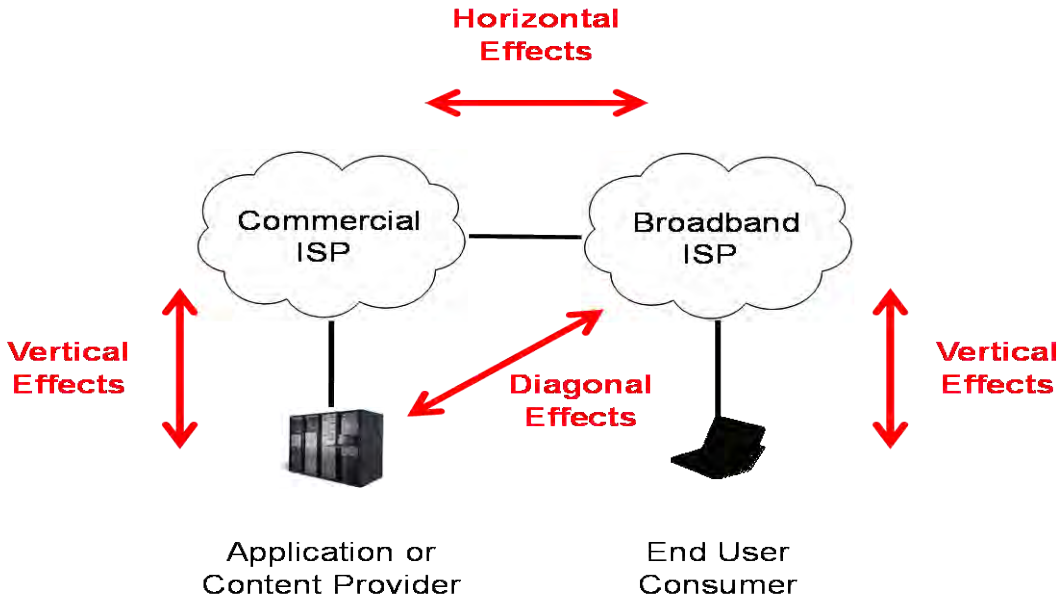
Vertical conflicts are upstream/downstream issues between an ISP and its customer, typically an end user consumer or else an Application or Content Provider. These vertical conflicts usually involve market power, and often contain an aspect of vertical foreclosure.

Horizontal conflicts are those between entities operating at the same level of the network value chain. Horizontal conflicts can arise between ISPs, especially between Broadband ISPs and Commercial ISPs. Horizontal issues are often linked to differences in bargaining power.

Diagonal conflicts arise between entities that are in different, but interlinked, value chains. Notably, a conflict between a Broadband ISP and an Application and Content Provider customer of a different ISP can be viewed as a diagonal conflict.

The vertical dimension denotes the network participant's place in the value chain, i.e., network provider versus end-user.

Figure 8: Vertical, horizontal, and diagonal network neutrality effects



Source: Marcus.

[84] This section is based on earlier work by this author and a colleague. See J. Scott Marcus, Kenneth R. Carter and Christian Wernick (2009), *Network Neutrality: Implications for Europe*, WIK, January 2009. Available at: http://www.wik.org/.

Box 5: Food for thought - The Comcast Netflix dispute

Comcast, a cable network operator that is the largest single broadband provider in the United States, has had a long-simmering dispute with Netflix for years. Comcast demanded, and Netflix resisted, payments for video streaming traffic between Netflix and consumers who viewed Netflix videos using Comcast's broadband network. As a result of the dispute, Comcast declined to upgrade interconnection capacity to Cogent, an ISP that carries traffic on behalf of Netflix.[85] The limitation to interconnect capacity visibly slowed traffic to Netflix customers, arguably to the detriment of all concerned.[86]

In the context of Figure 8, Netflix is the Content Provider, Cogent is the Commercial ISP, and Comcast is the Broadband ISP. Comcast and Netflix would not necessarily have had a commercial arrangement with one another. This conflict is a *diagonal effect*.

The recent 'resolution' of this complex dispute, if it can be called that, raises many questions that are central to the network neutrality debate on both sides of the Atlantic.

In February 2014, Netflix reached an agreement involving payments to Comcast. Prior to the agreement, performance to Netflix customers using Comcast had steadily degraded (see Figure 9). Over the subsequent three months, performance to Netflix customers using Comcast improved dramatically. Netflix traffic to no other ISP shows a comparable change.

Figure 9: Performance of Netflix traffic to customer over the Comcast network (July 2013 - May 2014).

Source: Netflix USA ISP Speed Index Results Graph[87]

[85] Netflix also uses various means to deliver its content, including Amazon and CDN solutions including Akamai, LimeLight, and Level-3. See Vijay Kumar Adhikari, Yang Guo, Fang Hao, Matteo Varvello, Volker Hilt, Moritz Steiner and Zhi-Li Zhang (2012), 'Unreeling Netflix: Understanding and Improving Multi-CDN Movie Delivery'.

[86] See Netflix public performance statistics, at: http://ispspeedindex.netflix.com/results/usa/graph.

[87] Viewed 26 August 2014 at: http://ispspeedindex.netflix.com/results/usa/graph.

Public statements by Netflix at the time may have confused the press and many experts, since Netflix seemed at the same time to be saying that they had gotten a good deal, and yet they regretted it. In hindsight, the statements do not seem to be inconsistent – they got a better deal than had previously been on offer (from which their customers benefit), but do not feel that they should have been have been obliged to strike a deal in the first place. Consider for instance this public statement by their CEO Reed Hastings: 'Netflix believes strong net neutrality is critical, but in the near term we will in cases pay the toll to the powerful ISPs to protect our consumer experience. When we do so, we don't pay for priority access against competitors, just for interconnection. A few weeks ago, we agreed to pay Comcast and our members are now getting a good experience again.'[88]

Drawing firm conclusions from this very important case study is challenging because there are so many plausible ways in which to interpret both the performance degradation and the agreement that ended it. Far more questions are raised than answered.

- Should the dispute be viewed as simply as a classic peering dispute (see Section 2.5) between a content-oriented Commercial ISP (Cogent) and an 'eyeball'-oriented Broadband ISP (Comcast)?
- Should the dispute be viewed as an example of vertical foreclosure (see Section 3.2) between a network operator with market power relative to its large consumer subscriber base, and a provider of video content that competes with the video content that Comcast (both as a Broadband ISP and as a cable network operator) provides in the upstream market segment to its subscribers?
- Should the dispute be viewed as an example of a two-sided market negotiation (see Section 3.3), where Comcast is a platform intermediating between Netflix and a large number of its users? In this context, are they merely searching for the most efficient way to divide the profits?
- To what extent was Comcast's willingness to make a deal influenced by its desire to remove a possible irritant relative to its intended merger with Time Warner Cable?
- To what extent was Netflix's willingness to strike a deal influenced by the US District Court's decision in Verizon vs. FCC (see Section 6.1.1), and the realisation that it wuld no longer be protected by network neutrality rules in the near to medium term?
- Are perhaps *all* of these considerations relevant to some degree?

4.3. Harms observed to date

In light of the high public concern over network neutrality, it is striking that there have been few incidents reported, and very few indeed that have risen to the level of requiring intervention on the part of NRAs or governments.

4.3.1. The situation today

As BEREC noted as recently as June of 2014, 'very few NRAs have reported specific relevant net neutrality incidents.'[89]

BEREC noted only two incidents, neither of which required explicit regulatory action. 'In France, the case of fixed ISP *free* blocking advertising in January 2013 led to an intensive public debate on net neutrality. Moreover, in April 2013, Deutsche Telekom's

[88] Reed Hasting (2014), 'Internet Tolls And The Case For Strong Net Neutrality', 20 March 2014, at: http://blog.netflix.com/2014/03/internet-tolls-and-case-for-strong-net.html.

[89] BEREC (2014a), 'BEREC Annual Reports – 2013', BoR (14) 60.

announcement to change its price structure for fixed-network IAS from 2016 raised concerns among internet activists and (some) public media that it might constitute a net neutrality violation.'[90]

It is clear that traffic differentiation is widespread;[91] however, traffic differentiation is not necessarily the same as harmful discrimination in our view (see Section 4.1).

A number of Member States have taken legislative action with regard to network neutrality, or have proposed to take legislative action (see Section 6.1.2). NRAs, however, have generally taken a light touch approach, responding to possible problems with a nuanced case by case approach. '[T]he prevailing approach among … NRAs is that possible deviations from net neutrality are dealt with on a case-by-case basis. An example of this approach is the statement published by BNetzA in June 2013 in reaction to the announcement of Deutsche Telekom that it will introduce traffic management. More generally, there is wide agreement among national regulators that the existing regulatory tools enable NRAs to address competition concerns related to net neutrality for the time being.'[92]

VoIP has been and arguably continues to be a problem area. ' "Skype and other online apps have been experiencing arbitrary restrictions of use for some time now," said Jean-Jacques Sahel, policy director for Europe, Middle East and Africa at Microsoft Corp. …, which owns the video-chat app. "To ensure that these bad practices stop and the Internet does not become a dirt road, we need clear rules." '[93]

A significant number of European Internet users believe that they have experienced blocking, at least once; however, the reasons are various, and by no means do all of them imply the classic network neutrality problem of blockage by the network operator. This is apparent in a large scale survey of European household conducted on behalf of the Commission in 2013.[94] Of those who believe that they have been blocked, an equal fraction (31%) believe that they have been blocked by the content or application provider versus the network operator, and an additional 9% attribute blockage to the provider of the device. Some 19% believe that they were blocked due to geographical content restrictions. These different forms of blocking have quite different public policy implications.

[90] Ibid.

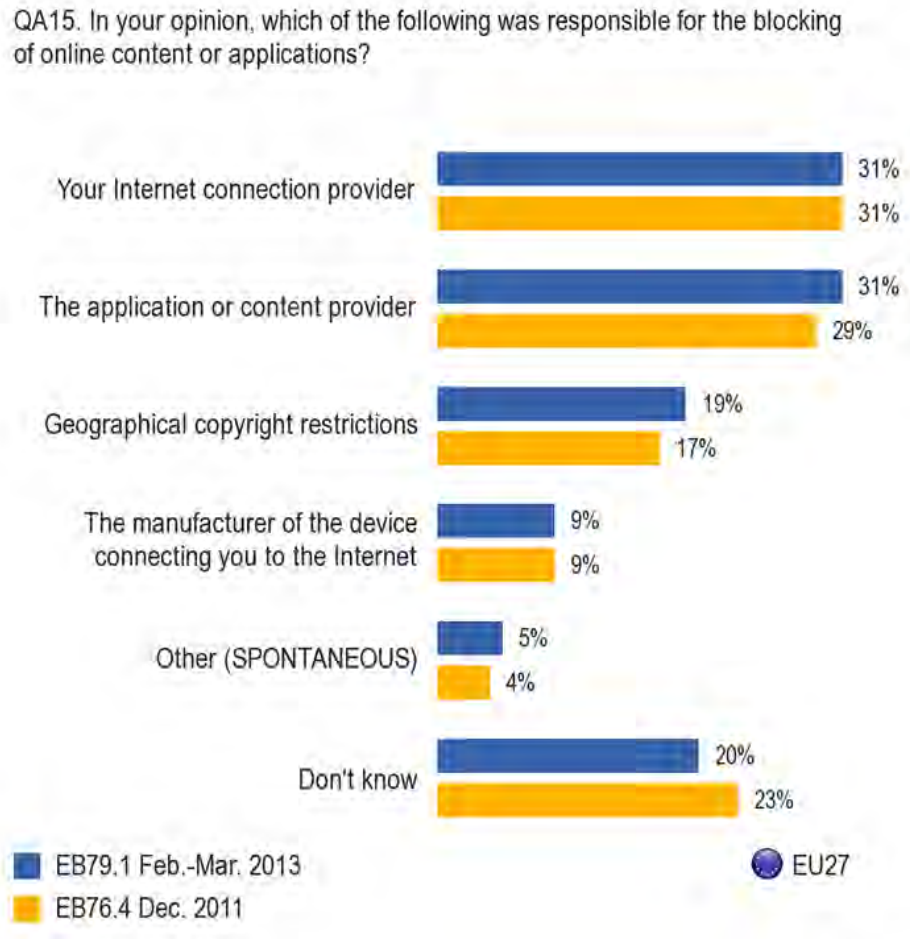
[91] See for instance Alissa Cooper (2013), How Regulation and Competition Influence Discrimination in Broadband Traffic Management: A Comparative Study of Net Neutrality in the United States and the United Kingdom. See also the Eurobarometer results presented later in this section.

[92] BEREC (2014), 'BEREC Annual Reports – 2013', BoR (14) 60.

[93] Sam Schechner and Ryan Knutson (2014), 'Telecoms Step Up Fight Over Net Neutrality', *Wall Street Journal*, 24 February 2014.

[94] TNS Opinion & Social (2013), Special Eurobarometer 396: E-COMMUNICATIONS HOUSEHOLD SURVEY REPORT; Fieldwork: February - March 2013, Publication: November 2013, on behalf of the European Commission, Directorate-General Communications Networks, Content and Technology.

Figure 10: User perceptions of the cause of blocking of online content or applications



Source: Eurobarometer 396 (2013).

A great many uncertainties exist today as to consumer attitudes toward network neutrality. An ongoing study on behalf of BEREC may shed further light on these attitudes (see Section 4.6).[95]

4.3.2. The situation in 2012

As of late 2012, the *Body of European Regulators for Electronic Communications (BEREC)* and its members were likewise of the view that serious deviations from network neutrality were rare. 'For the time being, the situation appears to be mostly satisfactory and problems are relatively rare, though this assessment should be nuanced, as the situation varies significantly between national markets. Having said that, the net neutrality debate is legitimate, since rapidly evolving practices make it credible – though not certain – that problems will arise more frequently in the future.'[96]

Then, as now, they felt that the tools available to the NRAs were adequate. 'BEREC is committed to the open Internet, and believes that the existing regulatory tools, when fully implemented, should enable NRAs to address net neutrality-related concerns.'[97]

[95] WIK-Consult and Deloitte (forthcoming), 'The Value of Network Neutrality to European Consumers'. This author is an adviser to the study.

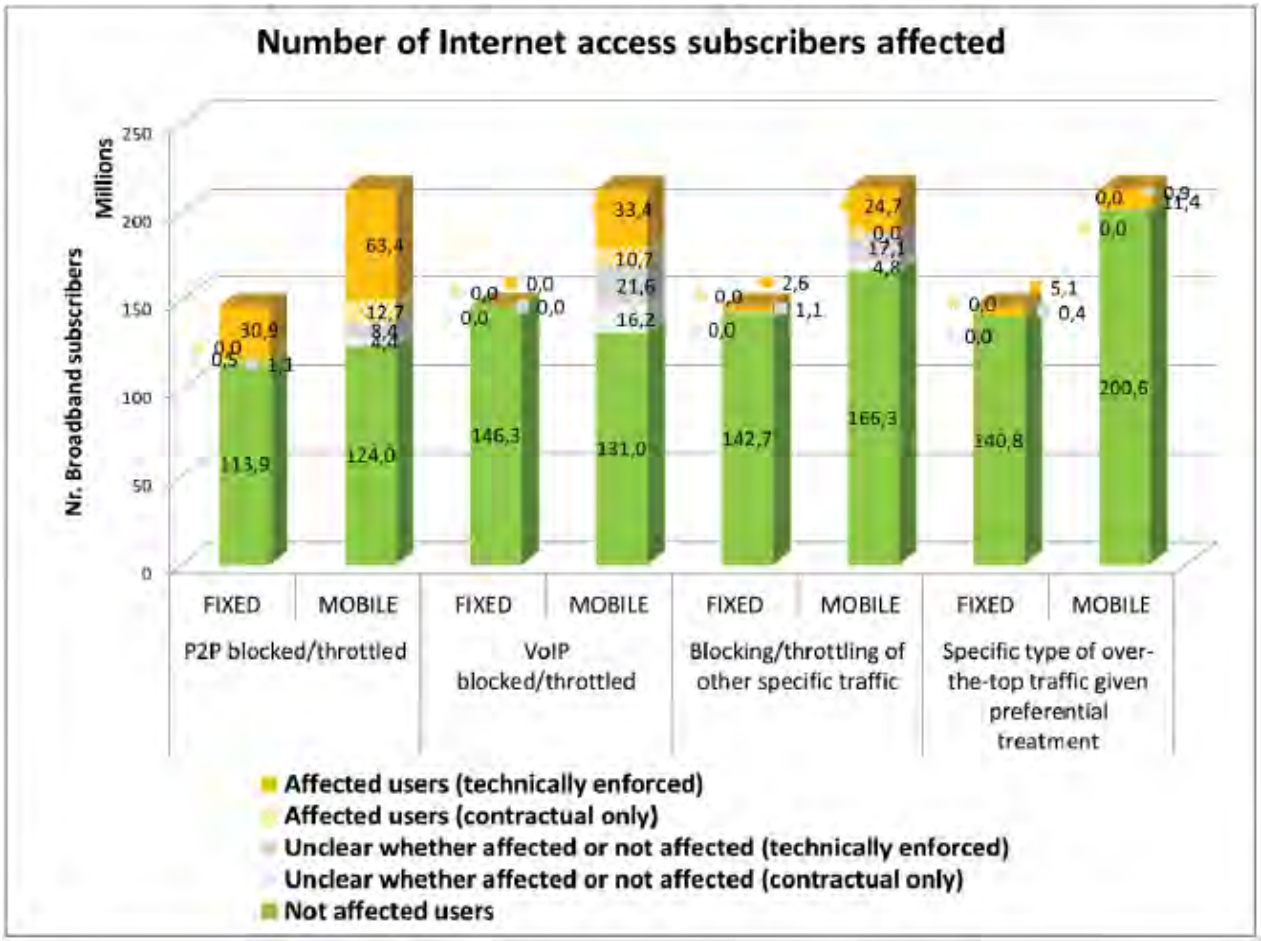
[96] BEREC (2012), 'Summary of BEREC positions on net neutrality', BoR (12) 146.

[97] Ibid.

This is not to say that no traffic management was taking place, or that no users were affected. A joint study by BEREC and the European Commission assessed the fraction of broadband users affected by traffic management.[98] The numbers subject to traffic management, especially for peer-to-peer (P2P) traffic and for Voice over IP (VoIP), was substantial (see Figure 11). Some were subject only to unenforced contractual restrictions, while others were subject to restrictions that were technically enforced.

Again, it is important to carefully consider whether these restrictions were on balance beneficial or neutral rather than harmful to the interests of consumers and society at large. Restrictions on P2P traffic, especially in the upstream direction, are not necessarily worrisome, since the traffic is large and is not necessarily time-critical. There could be valid reasons (from the perspective of the user base as well as the network operator) to restrict this traffic. Restrictions by mobile operators on VoIP traffic are more troubling, however, inasmuch as VoIP traffic is low-volume, delay sensitive, and associated with a service that directly competes with the MNOs' own mobile voice services. These restrictions might well be motivated by anticompetitive considerations.

Figure 11: Estimated number of European Internet access subscribers affected by traffic management practices (2012)



Source: BEREC (2012).[99]

[98] BEREC (2012), A view of traffic management and other practices resulting in restrictions to the open Internet in Europe: Findings from BEREC's and the European Commission's joint investigation, BoR (12) 30.

[99] Ibid.

4.3.3. The situation in 2010

BEREC's 2012 views are consistent with a wide range of previous findings. Notably, a key finding of the European Commission's 2010 public consultation on 'The open internet and net neutrality in Europe' was that there appeared to be a consensus among '…network operators, internet service providers (ISPs) and infrastructure manufacturers that there are currently no problems with the openness of the internet and net neutrality in the EU … In their view, traffic management exists to support the efficient operation of today's internet and does not have a negative impact on the consumer; indeed, some contend that traffic management actually enables the development of services at lower cost. They maintain that there is no evidence that operators are engaging in unfair discrimination in a way that harms consumers or competition. This general view is supported by a number of Member States.' The 2010 consultation noted scattered complaints, some of them credible, of (1) mobile network operators (MNOs) blocking or charging excessive prices for VoIP by certain mobile operators in Austria, Croatia, Germany, Italy, the Netherlands, Portugal and Romania, and of (2) blocking or throttling of traffic such as file sharing in France, Greece, Hungary, Lithuania, Poland and the United Kingdom.[100]

In its response to the Commission's public consultation,[101] BEREC noted that the incidents to date are relevant but 'may not necessarily represent breaches of network neutrality'; moreover, many were finally resolved 'without any formal proceedings', and the incidents 'have not led to a significant number of investigations by NRAs'.[102]

At the time, in sum, there appeared to be few if any documented, clearly problematic incidents in Europe, and no demonstrated, sustained pattern of systematic and abusive discrimination.[103] This is still largely the case today, with the possible exception of VoIP in mobile devices.

4.4. Benefits observed to date due to traffic management

In the face of concerns over network neutrality, there has been rather poor reporting of success stories.

Traffic management likely plays a large role in the successful introduction of Voice over IP (VoIP). Cooper (2013) is based on extensive desk research and interviews. She reports: 'One US cable engineer described how the impact of peer-to-peer traffic on customers of Vonage, a leading US VoIP provider, became an impetus for adopting peer-to-peer management: "[A]round 2005-6, Vonage started to get really big. We had constant calls from Vonage management, customers pissed off, that we were degrading Vonage's service. . . . [S]omething was going on the network, we didn't know quite what, that was impacting VoIP and other real-time applications. And so we were sort of feeling our way through that.

[100] European Commission, Information Society and Media Directorate-General, Electronic Communications Policy: Questionnaire for the public consultation on the open internet and net neutrality in Europe, 30 June 2010.

[101] See http://ec.europa.eu/information_society/policy/ecomm/doc/library/public_consult/net_neutrality/comments/04eu_national_regional_ministries_authorities_incl_berec/berec_x.pdf.

[102] In its response, however, BEREC reported cases of i) blocking, or charging extra for, Voice over Internet Protocol (VoIP) services in mobile networks by certain mobile operators; and ii) throttling of peer-to-peer (P2P) file-sharing or video streaming. VoIP providers and BEUC (a consumer advocacy organisation) also expressed concerns, both in their consultation comments and in our 2011 interviews.

[103] The Commission took a somewhat more nuanced position of the incidents identified by BEREC and others in 'The open internet and net neutrality in Europe', COM(2011) 222 final. 'The Commission does not have evidence to conclude that these concerns are justified at this stage but this should be borne in mind in a more exhaustive fact-finding exercise.'

We didn't really know much about it. But we knew that if we did some stuff in the network we could make that experience better. Demonstrably better."'[104]

With that said, it is troubling that the differentiation that is practiced in Europe, especially by mobile network operators, seems to primarily be against VoIP services rather than in their favour. This is visible, for instance, in stakeholder responses to the Commission's 2012 public consultation on network neutrality (see Section 5.4.3, and also 5.4.8). VoIP services are quite low in their bandwidth requirements, so this cannot be motivated by network capacity management. It is natural to suspect that these practices are motivated instead by a desire on the part of mobile operators to raise the costs of rivals who compete with them for voice services (i.e. economic foreclosure as discussed in Section 3.2).

Similar arguments would apply to real time videoconferencing. Prioritisation of traffic in order to ensure delay of less than some 200 milliseconds would clearly result in a much better service.

Certain real time games (especially 'shooter') games clearly would benefit from prioritisation in order to achieve reliable quality.

The use of public mobile Internet services for mission-critical applications is increasingly of interest. The police, fire, and emergency medical services (Public Protections and Disaster Relief, or PPDR services) have an increasing need for broadband. At the time of a natural or man-made disaster, this traffic *must* get through. If it is impossible to prioritise PPDR traffic, the use of expensive dedicated private networks (requiring high quality spectrum) might be unavoidable.

Similar concerns apply to transport, where for instance the European rail system is going to need a successor to GSM-R in the years to come. Absent prioritisation, the use of expensive, dedicated private networks might be unavoidable.

4.5. Measures in place at European Level

A general review of instruments already available to NRAs at European level appears in Section 6.1.2. For now, we briefly summarise the key powers of NRAs in addressing any network neutrality concerns that might emerge.

To the extent that network neutrality was addressed prior to 2009, it was (1) by ensuring that European end user consumers had sufficient competitive choice among network operators, and (2) by specific, loosely defined powers to intervene to ensure interconnection.

The changes enacted to the Regulatory Framework in 2009 primarily served to ensure that consumers were adequately informed about the practices of ISPs, and to lower switching costs if they were dissatisfied with those practices. The changes enacted in 2009 specifically empowered NRAs by means of:

- Amendment of Article 8 of the Framework Directive to establish the ability of end users to access content, applications or services of their choice as an explicit goal of European policy.[105]
- Amendment of Article 20 of the Universal Service Directive to oblige providers of electronic communication services to inform their end users of their practices in

[104] Alissa Cooper (2013), How Regulation and Competition Influence Discrimination in Broadband Traffic Management: A Comparative Study of Net Neutrality in the United States and the United Kingdom.

[105] 'The national regulatory authorities shall promote the interests of the citizens of the European Union by inter alia: … promoting the ability of end-users to access and distribute information or run applications and services of their choice; …'

regard to traffic management, and providing end users with the right to change providers without penalty if they are dissatisfied with a change in these practices.

- Empowerment of NRAs through Article 22(3) of the Universal Service Directive[106] to enable them to impose, if necessary, minimum QoS obligations on network operators.

In addition, Article 5 of the Access Directive was clarified to empower NRAs to deal with interconnection issues, even for network operators that do not necessarily possess *Significant Market Power* (*SMP*).[107]

4.6. Competition and harmful discrimination

Among European policy experts, including this author, it has been something of an article of faith that competition plays a strong role in deterring harmful discrimination. The thrust of the 2009 amendments to the Regulatory Framework were to ensure informed consumer choice and low switching costs in an already competitive environment. This seems logical, but there has never been much empirical evidence to back it up or to refute it.

A well-researched recent doctoral thesis may force us to think deeper about these issues. Cooper (2013) argues persuasively that increased intensity of competition, particularly to the extent that network costs are high, makes quality differentiation more likely, not less.[108]

This conclusion is probably right, as far as it goes, but still may not be the last word. Cooper (2013) does not distinguish between quality differentiation in general versus harmful, anticompetitive quality differentiation. Recall that differentiation can be welfare-enhancing, as for example in the case of prioritisation of VoIP traffic. Quality differentiation *per se* will not necessarily motivate switching, or deter behaviours on the part of network operators; rather, certain kinds of differentiation that runs counter to the interest of subscribers, or perhaps of certain narrower groups of subscribers, might motivate switching provided that consumers are aware of it. Clearly, we need a better understanding than we have today about the role of competition in deterring harmful differentiation.

Cooper (2013) also raises sobering concerns about willingness to switch, and about its deterrent value. 'Does competition deter discrimination? Certainly not in the UK in the way in which it has been envisioned in the literature, relegating discriminatory conduct to the margins. Instead, most consumers did not understand traffic management or use it as a basis for switching. Those who did do so comprised a group perceived to be small or insignificant enough that most ISPs did not seek to factor them into their product decisions, despite some consumers' complaints about traffic management. Competition may have effectively safeguarded the performance of the most popular applications, but not the nondiscriminatory application development environment as a whole.'[109]

A quote in Cooper (2013) bolsters this argument. 'A policy executive working for an Internet application company whose product had been discriminated against in the UK and

[106] 'In order to prevent the degradation of service and the hindering or slowing down of traffic over networks, Member States shall ensure that national regulatory authorities are able to set minimum quality of service requirements on an undertaking or undertakings providing public communications networks.' The text goes on to establish coordination mechanisms between the Member States and the Commission.

[107] '[NRAs] shall be able to impose: (a) to the extent that is necessary to ensure end-to-end connectivity, obligations on undertakings that control access to end-users, including in justified cases the obligation to interconnect their networks where this is not already the case; (ab) in justified cases and to the extent that is necessary, obligations on undertakings that control access to end users to make their services interoperable.'

[108] Alissa Cooper (2013), How Regulation and Competition Influence Discrimination in Broadband Traffic Management: A Comparative Study of Net Neutrality in the United States and the United Kingdom.

[109] Ibid.

elsewhere explained this aptly: "[T]he current competition between the ISPs or mobile operators can only be sufficient for the very few Internet services that are huge enough and indispensable enough, such as Google search, that consumers would switch tomorrow if they didn't have you. We're not even in that category. I think Facebook and Google are probably the only ones in that category, where if you didn't have them, the vast majority of users would just say, 'you're crazy' and move with their feet. Even us at [my company], we're clearly not important enough in consumers' minds." '[110]

This issue about large or valuable content providers versus smaller or lesser content providers is plausible to the extent that it echoes a discussion from the media world. There have been long-standing concerns that programmers, especially advertising-dependent programmers, need to be available on any platform that is big enough to matter. It was argued that this need effectively confers market power on all, or nearly all, broadcast transmission platforms. For highly sought after programmers such as sport channels, this is obviously not a problem since they have countervailing power; however, for programmers that are only moderately sought, or that are highly sought but by small numbers of viewers, they might be highly exposed to market power effects.

It is clear that more needs to be known. An ongoing BEREC study will hopefully shed more light on consumer attitudes toward network neutrality. As BEREC has noted, after investigating the actual practices, they identified the need to understand the reasons for the different traffic management responses of ISPs to similar technical, legal and market constraints, to examine how consumer expectations and market dynamics are reflected in practice in retail offers, and to measure the role and impact on net neutrality of competition, transparency and the ability of consumers to switch easily. BEREC therefore launched an external study to assess the value of net neutrality to consumers.[111]

4.7. Additional concerns going forward

A great many other concerns and risks have appeared in the extensive literature on network neutrality. In the interest of brevity, we will deal with only a few of them here:

- The risk that prioritised services might crowd out non-prioritised services;
- The risk that major content providers might use prioritised services to crowd out smaller content providers (e.g. content providers with fewer viewers or less financial resources); and
- Threats to freedom of expression.

4.7.1. Crowding out of non-prioritised services

The concern here is that network operators would choose to offer prioritised and/or specialised services in such a way as to make non-prioritised services unattractive or unusable. The network operators would make more money with prioritised services, so the theory goes, and would therefore have no interest in selling non-prioritised services at a lower price.

This was to some extent the case for voice services in Europe prior to the liberalisation of markets for electronic communications. Network operators offered 'gold plated' voice services at a higher quality and price than many consumers would have selected had they had a choice.

[110] Ibid.

[111] WIK-Consult and Deloitte (forthcoming), 'The Value of Network Neutrality to European Consumers'. This author is an adviser to that study through his firm, WIK-Consult GmbH.

This threat seems to be highly speculative. If broadband markets continue to be competitive, as they generally are today, it is difficult to see how a network operator could profit by offering only expensive, high quality services. They would lose market share to competitors who were willing to offer a cheaper alternative with quality sufficient to meet the needs of most users.

We know of no instance where a broadband provider was able to profit in this way in a competitive market. Indeed, if network operators believed that they could profit in this way, it seems likely that they would have already done so prior to the introduction of the first network neutrality rules.

These observations are broadly consistent with BEREC's findings in 2012.[112] It is not unusual for an integrated broadband providers that also offers services such as video to positively differentiate in favour of its upstream services, which 'do not necessarily raise competition problems'; negative differentiation however is characterised as a 'hypothetical situation' that 'when it negatively affects a large number of content providers, is referred to in the net neutrality literature as the "dirt road"'.[113]

BEREC goes on to observe that '[a] vertically integrated [broadband ISP with SMP in a retail internet access market] has incentives to discriminate traffic coming from [content and application providers] which provide contents or applications competing with its subsidiary. Users face negative effects …'[114]

The ability of a network operator to profitably discriminate in this way depends on the broadband ISP possessing SMP in the *retail market* for broadband access, as BEREC noted, and should therefore presumably be judged on a *modified greenfield* basis, i.e. after application of procompetitive remedies such as LLU, shared access and bitstream access. For a broadband ISP to have SMP on the wholesale market is quite a different matter from its having SMP on the retail broadband market.

For a broadband ISP without SMP on the retail market, 'a negative differentiation against one or several [content and application providers] is less likely, as customers would tend to switch to other [broadband ISPs]'.[115]

They conclude by noting that '[n]egative differentiation seems to be unlikely in a competitive market. That is the reason why this practice has seldom occurred up to now.'[116]

The idea of offering only premium services runs contrary to the basic economics of price and quality differentiation (see Section 3.1), based especially on the work of Hotelling (1929).[117] A network operator is motivated to offer different levels of quality, at different prices, because not all consumers have the same willingness to pay. Quality and price differentiation provide a means of earning more money because of these differences in willingness to pay. If all consumers were willing to pay a higher price (and if there were no competition), then the monopoly network operator would have already been charging the higher price. It is this lack of willingness to pay (together with the presence of competitors) that motivates the network operator to offer services at different levels of

[112] BEREC (2012), Differentiation practices and related competition issues in the scope of net neutrality, BoR (12) 132.

[113] Ibid.

[114] Ibid.

[115] Ibid.

[116] Ibid.

[117] Harold Hotelling, 'Stability in Competition', *The Economic Journal*, March 1929, pages 41-57.

quality in the first place. Offering solely or primarily a single level of quality means that the network operator does not benefit from differences in willingness to pay.

To offer an analogy, there are airlines that offer only economy tickets, but it is difficult to see why an airline in a competitive environment would choose to offer only first class tickets. The first class ticket effectively would become the standard ticket, and the price for it would be whatever the airline would have been able to charge in any case.

4.7.2. Crowding out of smaller content providers by major content providers

A concern that has sometimes been expressed is that the largest and most successful content and application providers would be willing to pay more than their smaller application and content competitors in order to squeeze them out of the market.

This concern also seems highly speculative, at least for now.

The companies that would presumably be best equipped to exercise a strategy along these lines are Google and Netflix. If either company believed that they could profit by using higher quality services to crowd out competitors, they would likely be lobbying for permission to use prioritised services. Instead, their lobbying appears to be nearly the opposite – it reflects concern over possibly being forced to pay for prioritised services. One can reasonably infer that the companies best positioned to execute this kind of crowding out strategy have already concluded that it is not profitable for them.

There is a variant of this strategy, however, that is relevant. Network operators that also function as IP-based providers of, for instance, audio-visual content are likely to benefit from prioritised delivery of that content by their respective networks. In their role as network operators, they will tend not to be motivated to offer prioritised delivery to competitive OTT providers of audio-visual content. This is a scenario that smacks of economic foreclosure, and that might merit attention. It is lightly touched on in a BEREC 2012 assessment.[118]

4.7.3. Threats to freedom of expression

Finally, the interest in network neutrality has sometimes been linked with a desire to counter threats to freedom of expression.

The threat to freedom of expression on the Internet today is real and palpable, especially in countries that seek to maintain authoritarian regimes in the face of popular dissatisfaction.

McDiarmid and Shears (2013)[119] make the argument in this way: 'The Internet reflects and has substantially advanced two central, forward-looking concepts of international free expression standards: borderlessness and choice. The Universal Declaration of Human Rights states, "Everyone has the right to freedom of opinion and expression; this right includes freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers."[120] Similarly, Article 19.2 of the International Covenant on Civil and Political Rights states, "Everyone shall have the right to freedom of expression; this right shall include freedom to seek, receive and impart information and ideas of all kinds, regardless of frontiers, either orally, in writing or in print, in the form of art, or through any other media of his choice." As a

[118] BEREC (2012), Differentiation practices and related competition issues in the scope of net neutrality, BoR (12) 132.

[119] Andrew McDiarmid and Matthew Shears (2013), 'The Importance of Internet Neutrality to Protecting Human Rights Online', in *The Value of Network Neutrality for the Internet of Tomorrow*, Dynamic Coalition for Network Neutrality.

[120] Internal Covenant on Civil and Political Rights, Article 19.

decentralized global network, the Internet offers individuals unprecedented power to seek and impart information across borders. It offers not only unprecedented global reach for individual speakers, but also unprecedented capacity for diverse information sources …'

These concerns are valid, but they may have different implications within Europe versus globally. Within Europe, freedom of expression already enjoys strong protection, and is moreover already protected by Article 8 of the Framework Directive (2009), which establishes the ability of end users to access content, applications or services of their choice as an explicit goal of European policy.[121] The principle that access to content should not be blocked on ideological grounds seems to be sufficiently well established.

A number of authors have expressed concerns about quality differentiation and its possible impact on freedom of expression in Europe; however, the use of quality differentiation to impede freedom of expression seems to be only a minor concern for Europe. First, problematic network neutrality incidents continue to be rare in Europe (see Section 4.3). Second, the measures that have been undertaken in 2009, together with any that emerge from the Telecoms Single Market (TSM) process (see Section 6.1.2), will probably be more than sufficient to deal with threats to freedom of expression in Europe.

Globally, threats to freedom of expression are a serious matter. It is highly unlikely that network neutrality initiatives alone are sufficient to address these threats, but they might conceivably represent a small piece of a broader solution.

[121] "The national regulatory authorities shall promote the interests of the citizens of the European Union by inter alia: … promoting the ability of end-users to access and distribute information or run applications and services of their choice; …"

5. STAKEHOLDER VIEWS ON NETWORK NEUTRALITY

KEY FINDINGS

- The Commission conducted a public consultation on network neutrality at the end of 2012, with an eye to a legislative initiative in 2013. For whatever reason, the Commission never published a comprehensive analysis of the results of that public consultation; nonetheless, the 131 non-confidential textual stakeholder responses are publicly available, and generally are thoughtful and of high quality. It is therefore possible to effectively complete the public consultation today, and thus to build this report on a firm foundation.[122]

- The Commission's 2012 public consultation on network neutrality could perhaps be said to have reached a consensus to the effect that traffic management on the part of ISPs can be permissible in general under suitable conditions; however, traffic management is not permissible when it is used in anticompetitive or harmful ways, such as blocking legitimate content or applications, unreasonably degrading services, or impeding services competing with the ISP's own services.

- A mix of different traffic management tools is used in different ways in Europe today, and in many cases with different objectives.

- Stakeholder views on traffic management measures were diverse. Citizens were troubled by most forms of traffic management, but troubled by some forms more than by others. Among organisational stakeholders, different perspectives were visible among NRAs, ISPs, content providers, and consumer advocates. Most considered traffic management to be appropriate under suitable preconditions.

- For restrictions on specific applications (VoIP, P2P), network operators had (unsurprisingly) a dramatically different perspective from that of applications and content providers. Consumer advocates and other civil society organisations appear to be deeply troubled by limitations on Voice over IP (VoIP).

- Substantially all organisational respondents agreed that for a network operator to prioritise its own traffic ahead of traffic for applications that compete with its own services is problematic.

- A wide range of stakeholders felt that for the Member States to implement divergent approaches would carry substantial risk.

- Stakeholders expressed varied views on the need for new legislative and/or regulatory measures. Some saw an urgent need for legislative measures, others (including BEREC and most NRAs) felt that current instruments were sufficient.

In mapping out a course going forward for such a complicated topic, it is important to have a clear understanding of the state of play in Europe today, and of the views of stakeholders. A nuanced understanding of stakeholder views as to which traffic

[122] We gratefully acknowledge the Commission's prompt and helpful assistance in processing the more than 400 multiple choice responses from the public consultation.

management practices should be viewed as appropriate, and which as problematic, is particularly important.

In this section, we provide a detailed assessment, based on results from a European Commission public consultation that was conducted in preparation for the legislative initiative that became the Telecoms Single Market Regulation. As we explain in Section 5.1, the results of that public consultation were analysed only to a very limited extent, and were published only in a very abbreviated form late in 2013; however, the responses (many of which are of very high quality) are available, and have served as a legitimate input to this study.

We have conducted that analysis on a reasonably representative subset of the non-confidential consultation responses. This chapter can be viewed as an abbreviated summary of the results of that public consultation.

5.1. The public consultation: an underappreciated resource

As explained in Section 1.4, a major legislative initiative such as the Telecoms Single Market Regulation would normally have been accompanied by comprehensive public consultation, which would have served as a crucial input to the Impact Assessment report. As is well known, no overall, comprehensive public consultation was conducted.[123]

As it happens, however, the Commission *did* conduct a public consultation on network neutrality at the end of 2012,[124] with an eye to a legislative initiative in 2013. For whatever reason, the Commission never published a comprehensive analysis of the results of that public consultation. Nonetheless, the 131 non-confidential textual stakeholder responses are publicly available,[125] and generally are thoughtful and of high quality. It is therefore possible to effectively complete the public consultation today, and thus to build this report on a firmer foundation.

We gratefully acknowledge the Commission's prompt and helpful assistance in processing the more than 400 multiple choice responses from the public consultation.

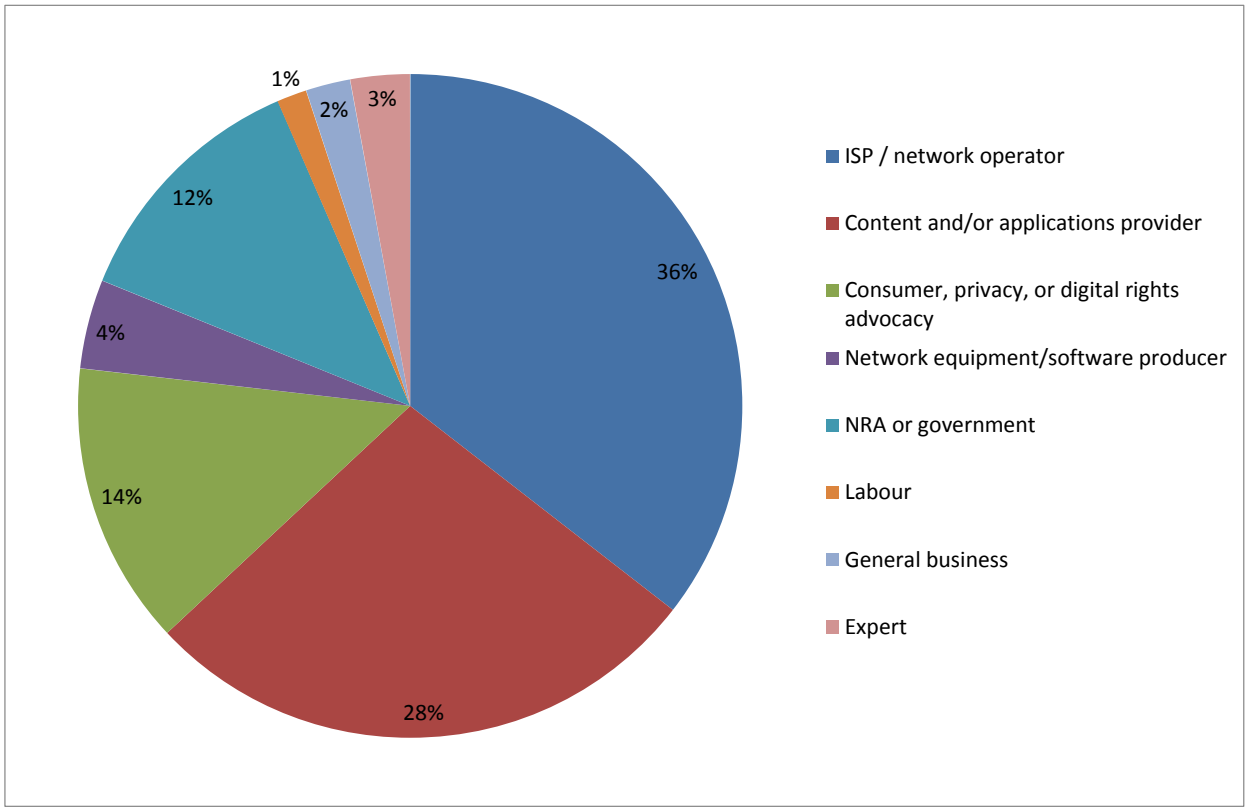
131 organisations and experts provided non-confidential opinions. The responses represent a mix of network operators / ISPs, content and application providers, network equipment and software providers, consumer advocates, labour, general business, and individual experts (see Figure 12). On many issues, there were strong differences of opinion among these different groups of stakeholders; on other issues, however, there was a degree of consensus.

[123] European Parliament Impact Assessment Unit (2013), 'Initial appraisal of a European Commission Impact Assessment European Commission proposal on a European single market for electronic communications and to achieve a Connected Continent'.

[124] The questionnaires and all non-confidential responses are available on the Commission's web site. European Commission (2012), 'Answers from the public consultation on specific aspects of transparency, traffic management and switching in an Open Internet', at http://ec.europa.eu/digital-agenda/en/news/answers-public-consultation-specific-aspects-transparency-traffic-management-and-switching-open.

[125] See http://ec.europa.eu/digital-agenda/en/news/answers-public-consultation-specific-aspects-transparency-traffic-management-and-switching-open.

Figure 12: Kinds of stakeholders that responded to the Commission's late 2012 network neutrality consultation



Source: Marcus.

We reviewed 28 of the 131 free form non-confidential text responses in detail, taking care to include a mix of respondent categories. We concentrated on those issues that are of particular relevance to this study.

The public consultation dealt with (1) current traffic management practices in Europe (see Section 5.3), (2) appropriate versus inappropriate forms of traffic management (see Section 5.4), opportunities and risks associated with new services (Section 5.5), Deep Packet Inspection and its implications for privacy and data protection (see Section 5.6), interconnection (including both QoS-aware interconnection and Content Delivery Networks (CDNs) (Section 5.7), the risk of divergent policy interventions among the Member States (Section 5.8), and the path to be taken going forward (Section 5.9).[126]

The public consultation also contains a wealth of valuable information about the need for transparency, the information that should be provided to consumers, the difficulty of switching ISPs, and a range of other important issues. They are not reported here, either because they seem to be less crucial or less contentious than other issues.

A number of organisations that represent holders of intellectual property rights were primarily concerned about piracy and other threats to the value of those rights. This is an important topic, but we view it as being out of scope for this study.

It is worth noting that the range of opinions is wide. Apparently contradictory views can be found even among different government agencies within the same country (for instance,

[126] There was a short questionnaire for individuals, and a more extensive questionnaire for organisations. See: http://ec.europa.eu/digital-agenda/en/news/answers-public-consultation-specific-aspects-transparency-traffic-management-and-switching-open..

the NRA, the media authority, the privacy authority, and/or the public consumer advocate). For that matter, some responses seem to contradict themselves in certain aspects. Be that as it may, we have attempted to report the views as stated.

There was some repetition among the text from different respondents, possibly reflecting coordination by their respective trade associations. We do not view this as problematic per se, but it suggests that counting the number of respondents who expressed a particular opinion may be of limited value.

5.2. The Commission's summary of the results

The Commission has provided a very brief summary of the Public Consultation results in the Impact Assessment document for their Telecoms Single Market proposals.[127] We reproduce the Commission's summary here, since it is brief and generally accurate.

> *'[A]ll stakeholders agree that some traffic management measures, when done for legal requirements, security or for unavoidable technical reasons such as temporary congestion management, are reasonable and part of managing the ISPs infrastructure to have a sustainable business model.*
>
> *ISPs go further by emphasizing the necessity of traffic management. Fixed operators emphasized that traffic management practices are indispensable to ensure a robust, secure and efficient functioning of the network and should be regarded as a commonly accepted technique for network optimization. Mobile operators stressed that traffic management is even more important in their sector due to the traffic-sensitive characteristics of their infrastructure. Furthermore, ISPs see traffic management practices as an essential tool to support innovative services and new business models by allowing differentiation in products and services.*
>
> *However, content providers stressed that traffic management should remain proportional and not harmful. They warn that traffic management should not be applied in anti-competitive and other harmful ways, such as blocking legitimate content and applications or unreasonably degrading services. Such practices can be detrimental to innovation in general.*
>
> *Although end-users organizations acknowledge that temporarily reasonable traffic management is necessary to combat congestion, they argue that it may never be used for commercial reasons.*
>
> *In general all traffic management measures were considered as problematic by citizens (in varying gradations). Traffic management was found problematic by 80% of responding citizens when used, without other grounds, against services competing with the ISP's own services. The least problematic were found: measures affecting (similar) applications/content providers of the same category in the*

[127] European Commission (2013), 'Impact Assessment accompanying the document "Proposal for a Regulation of the European Parliament and of the Council laying down measures concerning the European single market for electronic communications and to achieve a Connected Continent, and amending Directives 2002/20/EC, 2002/21/EC and 2002/22/EC and Regulations (EC) No 1211/2009 and (EU) No 531/2012"', 11 September 2013, SWD(2013) 331 final, COM(2013) 627 final, SWD(2013) 332 final.

same way (only 48% of citizens found it problematic)[128] *and measures affecting all applications/content providers in the same way, i.e. application-agnostic traffic management (only 30% of citizens expressed concerns).*

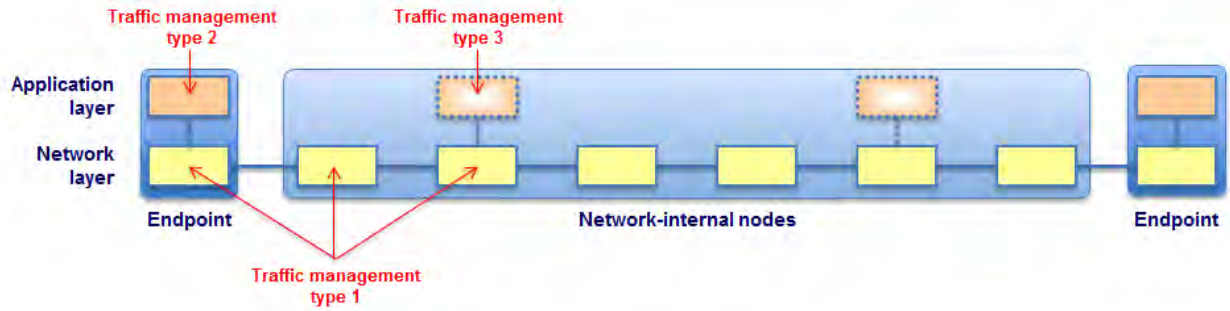
… [A]ll stakeholders (ISPs, CAPs and end-users) agree that transparency is key for end-users. Regarding the importance of certain parameters to be communicated to end-users, several ISPs, CAPs and public authorities raised that there should be a good balance between overburdening the customers with unnecessary information and over-simplification'.

5.3. Traffic management techniques in use in Europe today

Several consultation responses serve to provide a clear summary. All recognise that a mix of different tools is used in different ways, and in many cases with different objectives.

- **BEREC:** Different traffic management (TM) techniques can be classified according to which layer they are performed at and which network nodes they are performed in, ranging from internal to external network nodes and from the network to the application layer. BEREC uses the following three traffic management categories:
  - traffic management techniques executed at the network layer;
  - traffic management techniques executed above the network layer in the endpoints;
  - traffic management techniques executed above the network layer in network-internal nodes.

Figure 13: Types of traffic management as per the BEREC response to the Commission's 2012 public consultation



Source: BEREC.

Internet service providers (ISPs) deploy and manage their networks according to the traffic load generated by the end users. The aim is to achieve a network performance that is sufficient to run applications with adequate performance. The basic concept used by ISPs is that transmission capacity is deployed at different network links according to the traffic load that is usually expected.

[128] Some experts have advocated an approach to network neutrality regulation along these lines. See for instance Barbara van Schewick (2014), 'Network Neutrality and Quality of Service: What a Non-Discrimination Rule Should Look Like', Stanford University Public Law and Legal Theory Working Paper Series: Research Paper No. 2459568, John M. Olin Program in Law and Economics Working Paper Series: Paper No. 462, *Stanford Law Review*, Volume 67, Issue 1 (2015) (forthcoming).

TM type 1 includes functions performing routing and forwarding of individual Internet protocol (IP) packets over the different links available in the network, based on the destination address of the packets or similar information in the packet header.

TM type 2 includes such functions as congestion control and dynamic adaptive coding. Congestion control (not to be confused with congestion management, see question 4) is an automatic adjustment of the transmission rate at which data are sent into the network, i.e. the rate is adjusted according to the traffic load in the network.

TM type 3 includes techniques referred to as traffic filtering, traffic shaping and similar terms, and it often uses so-called deep packet inspection (DPI). Based on a predefined policy, individual IP packets may be forwarded, delayed or dropped.

When IP networks provide different traffic classes or priority levels, both type 3 and type 1 are involved. First, packets are sorted into traffic classes which may use some TM type 3 function. Then packets are forwarded through the network using separate queues per traffic class using some TM type 1 function (e.g. DiffServ or MPLS).

This appears to be broadly consistent with a range of statements from market players.

- **Cisco Systems:** Traffic management include all measures a provider has to take to successfully carry traffic in his networks. This starts with network and capacity planning, routing strategies, assigning spare capacity in case of failures, definition of policies for fair use, volume caps, congestion management etc. Broadly speaking, there are four major types of network management: (1) Specialized IP Routing: Internet service providers ("ISPs") rely on routing technologies to allow them to adhere to service level agreement guarantees in the face of network congestion and quality of service requirements. IP routing creates a virtual path that data will follow as it moves across a network or networks to its ultimate destination. Taken simply, within the network data is directed, using the destination IP address in the packet header, according to forwarding tables used by routers based on a series of protocols. By employing IP routing that responds to prevailing traffic demands, broadband providers engineer traffic patterns to improve performance. IP routing technology innovations include multi-protocol label switching ('MPLS'), a data-carrying mechanism by which data packets are assigned labels and forwarding decisions are made solely on the basis of these labels, without the need to examine the packets themselves. As a result, virtual links can be created between distant nodes using any protocol, further enhancing reliability. (2) Packet Differentiation (using so called 'DiffServ model'): Originally envisioned by the Internet Engineering Task Force, the DiffServ model allows for IP quality of service distinctions to be applied to various groupings of network traffic. Data will be classified into different classes of network traffic, which will define how that network traffic is forwarded as it flows across different routers in the network. Data traffic may be further conditioned by tools such as metering, marking, policing and shaping in order to adhere to service level guarantees or to address network challenges. These traffic tools can be used to reduce load peaks and queuing delays and to assure that the most important traffic goes out first. For instance, in a network that is subject to congestive collapse, traffic conditioning can be used by an ISP to ensure that the packets associated with an emergency government communication are transmitted with a minimum of loss or jitter. (3) Filtering: Filtering can be performed at various places in the network and involve multiple protocol layers. In access networks filtering happens at the ingress to the network, typically on layers 2 and 3, in order to prevent inappropriate use of the network. This is, e.g. performed by access control lists that determine undesirable packets which will then be discarded. In this context also policing is relevant which prevents subscribers from exceeding the

transmission speed as defined by their contract. Filtering on higher layers is also performed inside the network to enforce more sophisticated policies related to types of applications. For the analysis of higher layer protocol information deep packet inspection (DPI) is used. (4) Caching: Some content providers and broadband networks operators have developed content distribution methods that would involve direct interconnection and caching of content not just close to the broadband provider‘s access/aggregation networks, but within those networks as well. This enables end users to gain access to that content with shorter latency and reliably. It brings the customers the quality of experience he chooses for the content he wants. This will be essential for the management of the data explosion.

- **Vodafone** emphasised the wide range of use of traffic management mechanisms.
    - **To protect users:** Traffic management is also used by Vodafone to intercept and block viruses, malware and spam before they reach the end user. Without this, customers would be subject to virus and malware attacks that could put at risk the integrity of their devices. The user experience is also enhanced by substantial reduction of spam (unsolicited emails).
    - **To reduce network congestion and enhance network resilience**: Traffic management allows Vodafone to manage capacity hungry applications if there is congestion to ensure that all network users can continue to use the network. Mobile networks are designed to take expected traffic demand in different geographic areas into account. This is done by increasing the number of sites or the amount of valid spectrum in high demand areas. However, unpredictable factors may cause sudden increases in traffic demand in specific areas generating congestion. In these circumstances, traffic management is used to slow down applications that consume capacity but which can operate at lower speeds. This is implemented to prevent congestion affecting all users.
    - **To enhance user experience:** Traffic management allows the network to recognise certain types of applications and to implement optimisation techniques to enhance their user experience and reduce the risk of congestion. Typical examples are video/image optimisation and compression techniques. For example, the network can recognise that the end-user is using a smartphone and automatically adapts the resolution of images and video to the characteristics of that terminal."

5.4. Problematic versus appropriate traffic management

As noted in Section 5.3, traffic management is widely implemented in Europe, and in many different ways. A key question is the degree to which various forms of traffic management should be viewed as being problematic.

In previous sections of this report, we attempted to provide our own objective assessment as to whether various forms should be viewed as being problematic per se based solely on objective technical, economic, or policy considerations (in Chapters 2, 3, and 4, respectively). Clearly, however, difficult judgment calls are involved, and the subjective perceptions of stakeholders are important.

Network neutrality appears to be an issue for which where one stands is to a significant degree a function of where one sits. Substantially all subscribed in one way of another to the principle of an Open Internet, but different kinds of stakeholders had very different views as to what constituted appropriate traffic management.

Taken as a whole, the citizen responses appear to reflect a high degree of concern over traffic management – even greater, in many cases, than that of consumer advocacy groups. *These numbers need to be interpreted with care, however, since the consumer sample probably reflects a substantial degree of self-selection bias* – consumers who are troubled by traffic management practices were probably far more likely to respond than those who were satisfied with current practices, or who were unaware of the discussion. BEREC is in the process of conducting a survey of consumer attitudes toward net neutrality that will be based on a random sample, which should provide a stronger foundation for analysis going forward. Those data are expected to be available in the first half of 2015.[129] For now, the quantitative tabulation of the 2012 Public Consultation may represent the best source available, such as it is.

The perceptions of network operators predictably were somewhat at odds with those of content providers and consumer advocates, but there were points of commonality. Nearly all agreed that some forms of traffic management were appropriate under some circumstances. We review the details in the sections that follow.

Differences among stakeholders were particularly great as regards traffic differentiation against specific services such as VoIP (see Section 5.4.2); conversely, there was more or less universal agreement that for a network operator to differentiate against services that compete with services that it itself offers is (in the absence of some specific justification) problematic (see Section 5.4.7).

5.4.1. Used to ensure a guaranteed quality of service for a specific content/applications

Among citizens who responded, 9.2% felt that measures 'applied to deliver managed services (e.g. to ensure a guaranteed quality of service for a specific content/applications)' were necessary, 25.4% felt that they were appropriate, and 65.3% felt that they were problematic.

Different perspectives were visible among NRAs, ISPs, content providers, and consumer advocates. Most considered this practice to be appropriate under suitable preconditions.

In this section, and the subsequent sections, we present representative responses from NRAs, network operators / ISPs, content and application providers, and consumer advocates in that order.

BEREC explained the criteria that they advocate in evaluating such services. 'BEREC proposes to evaluate 'reasonableness' of TM and contractual restrictions by resorting to the following assessment criteria:

(i) Non-discrimination between players. This means that the practice is done on a non-discriminatory basis among all content and application providers (CAPs).

(ii) End-user control. It is an important indicator of reasonableness when the practice is applied on request of users at the edge, who can deactivate it.

(iii) Efficiency and proportionality. The measures should be limited to what is necessary to fulfil the objective, in order to minimise possible side effects. The intensity of the practice, such as frequency and reach, is also important when assessing its impact.

(iv) Application-agnosticism. As long they are able to achieve similar effect, BEREC expresses a general preference for 'agnostic' practices regarding contents and applications. This parallels the fact that the decoupling between network and application layers is a characteristic feature of the open Internet, and has enabled innovation and growth.'

[129] WIK-Consult and Deloitte (forthcoming), 'The Value of Network Neutrality to European Consumers'.

NRAs generally seem to support traffic management of this type under suitable circumstances. For instance:

- **FICORA** (Finland): 'ISPs need to adopt some traffic management practices to ensure an efficient use of their facilities and to guarantee the quality promised to the customer. Certain IP services, such as fire alarms, traffic light controls, real-time IPTV, VoIP and video conference, may require special traffic management to ensure a predefined high quality of service.'
- **Technical Surveillance Authority of Estonia**: 'If end-user is aware of this kind of traffic management policy (it is defined in service agreement) and it helps to ensure better quality of service or content to end-user then it is appropriate. If end-user is not aware of it, then it would be problematic. Anyway ISP should not prefer one application to another – all similar application or content providers should be treated same way.'

Most network operators / ISPs were generally supportive of the practice. This is true of both incumbent and competitive operators; however, smaller ISPs and the associations that represent them sometimes opposed traffic management as a means of providing managed services.

- **Deutsche Telekom**: 'They are necessary because specific services have specific requirements. Traffic management is the means to assure that these requirements are adequately met.'
- **The European Competitive Telecommunications Association (ECTA)**: 'Traffic management techniques are essentially used by operators to streamline their own networks and avoid any network congestion. Traffic management technology is the first tool by which Network Operators are able to give the opportunity for all customers to use networks and services on equal terms.'
- **The European Telecommunications Network Operators' Association (ETNO)**: 'Necessary and appropriate. Individual services have specific requirements. Traffic management is the necessary means to assure that these requirements are adequately met. Without traffic management, control admission and guarantee of capacity, one could not provide services at guaranteed quality which correspond to an essential part of the customer demand. Neither could one provide services requiring a high performance of the network (ex TV on ADSL).'
- **Associazione Italiana Internet Provider**: With the exception of VPN/MPLS managed services (that we consider not included in this consultation), we feel that this traffic management practice is inappropriate and inefficient. Also from an investment allocation … If correct capacity planning is applied (which is also necessary to achieve the ambitious aims of the Digital Agenda …) there is no congestion and therefore all traffic is carried with the quality that the IP network can provide give physical constraints. The bottleneck, if any, could be on the end-user's line, and in that case it will be the user to decide how to utilize such connection, and customer CPE equipment can be programmed to prioritize outbound traffic according to the user's wishes. Despite of what many big ISP say, the quality of the bandwidth is normally agnostic and not connected to given services and applications. When specific quality is needed, normally service and content providers have enough resources and expertise to provide customers with the needed quality. In addition, we believe that shifting content management from the content/service provider to the ISP means shifting responsibility for choosing what content will be carried and how to entities (the ISPs) which did not create it (and does not consume it).'

Different content and application providers had different views, but most accepted traffic management for managed services under some circumstances.

- **The European Broadcasting Union (EBU)**: 'Traffic management measures are an appropriate means to deliver managed services. We believe that a managed lane can co-exist with the best efforts Internet lane. However, we'd like to reiterate that the open Internet should remain the norm and not the exception.'
- **The European Grouping of Societies of Authors and Composers (GESAC)**: 'Traffic management and packet inspection are central to the efficient evolution of the internet and this has always been the case. These tools do not jeopardise the net freedoms but rather can be deployed to guarantee quality of service to users, to protect them from harmful content and to contribute to the development of creative content by protecting rights holders from theft.'
- **The Voice on the Net (VON) Coalition Europe** (VoIP providers iBasis, Google, Microsoft, Skype, Viber, Vonage, Voxbone and WeePee): 'Looking more specifically at managed services, VON believes it is important to stick by the principle that managed services should be understood as services that are separate from Internet access. If looked at in this manner, managed services can be offered by ISPs provided that they do not discriminate in a way that is anticompetitive, creates barriers to innovation, or harms end-users and consumers using ISPs' non-managed Internet access services. More specifically, VON considers that safeguards are necessary to ensure the quality of Internet access, in order to avoid a "dirt road" effect, in parallel to the possibilities for operators to offer managed services.'

Among consumer advocacy groups, most accepted this practice under suitable conditions.

- **BEUC**: 'The commercialisation of so-called managed services is a legitimate business option for network operators and ISPs as long as the management of these services never undermines the services they provide to access the Internet. These managed services may require specific quality of service for them to work properly, which in turn requires specific traffic management techniques. Therefore, National Regulatory Authorities should ensure that operators and ISPs run managed services in a way where there is no adverse impact on the delivery of the best effort Internet.'
- **Verbraucherzentrale Bundesverband**: 'Operators and ISPs need to find a way to run the two services (i.e. managed services and best effort Internet access services) as separate as possible, in order to ensure the minimum Quality of Service (QoS) that is expected from their Internet access services and to which they are bound by the services' contracts.'
- **Which?**: 'Network operators and Internet Service Providers use traffic management measures for different purposes. Some measures, when done for legal requirements, security reasons, or technical reasons such as temporary congestion management, are reasonable and necessary for a sustainable business model. Unfortunately, some measures may be used for commercial reasons and are detrimental to consumers and the neutrality of the internet.'

5.4.2. Taking into account the sensitivity of the service to delay or packet loss

Among citizens who responded, 13.4% felt that measures 'taking into account the sensitivity of the service to delay or packet loss' were necessary, 32.8% felt that they were appropriate, and 53.8% felt that they were problematic.

Positions largely parallel those taken on managed services. In this section, and in the subsequent sections, we present representative responses from NRAs, network operators / ISPs, content and application providers, and consumer advocates in that order.

- **The European Competitive Telecommunications Association (ECTA)**: 'It should be considered that when services are sensitive to delay or packet loss (e.g., Voip, On line gaming, etc.) traffic management is the only way for service continuity assurance.'
- **The European Telecommunications Network Operators' Association (ETNO)**: Necessary and appropriate. In many cases, IP service provision will depend on traffic management which caters for specific service requirements, for example as regards delay and packet loss, making it both necessary and appropriate.
- **European Broadcasting Union (EBU)**: 'Any traffic management practices (i.e. throttling) on the public open Internet should be kept to a minimum and should be allowed only in specific cases (i.e. to alleviate congestion on the network during peak times, to preserve the integrity of the network, user equipment, services or applications or to comply with a legal justification or Court order). Traffic management taking into account the sensitivity to delay or packet loss is only appropriate provided that it is limited to a strict minimum, that it is properly justified and that equal types of traffic are treated equally. Video traffic is indeed sensitive to IP packet loss or delay. But we do not believe that traffic management should be the ultimate solution for dealing with network congestion as they do not ensure an optimal user experience on the public open Internet. Furthermore, in so far as traffic differentiation practices are used as the main tool for dealing with network congestion, maintaining these practices act as a disincentive for network investment. It is the EBU view that that the solution is a combination of investment in additional capacity and advanced technical solutions for efficient traffic delivery … Traffic management techniques taking into account the sensitivity of the service to delay or packet loss should not be used as a means to avoid the necessary investments in additional capacity.'
- **The Voice on the Net (VON) Coalition Europe** (VoIP providers iBasis, Google, Microsoft, Skype, Viber, Vonage, Voxbone and WeePee): As noted in Chapter 2, VoIP could and should potentially benefit from favourable management of Quality of Service (QoS). It is therefore striking that a major association of European VoIP providers is concerned about degradation of QoS rather than enhancement. 'Voice over IP (VoIP) is particularly sensitive to degradations in network performance (especially in terms of latency requirements), and because of its reliance on peer-to-peer (P2P) in some cases, it can be faced with various network management impediments put in place by access operators. VoIP and video communications can be especially harmed by temporarily delaying sessions using peer-to-peer or other applications and protocols, due to their reliance on a steady stream of real-time communication packets. Limiting or delaying a VoIP session or video communication can be tantamount to blocking, that is negating a user's ability to communicate. Even when VoIP packets are delayed a mere 250 milliseconds, the lag is noticeable and impedes speech communications.'
- **Aruba S.p.A.** (a content and application provider): 'It's appropriate to consider service sensitivity to delay or packet loss. It's inappropriate to get this goal through traffic management techniques. We consider fundamental for ISPs to diffuse a correct and complete description of service and its features (even in terms of malfunctions and possibility of packet loss delay). Under a certain service and its

characteristics, user must CHOOSE which contents must be conveyable and CHANGE his choices whenever he wants.'

- **BEUC**: 'Different services and applications require different qualities of service, so it is reasonable that ISPs adapt their traffic management to be able to ensure the necessary QoS for the delivery of each service. It is nonetheless very important that this traffic management is done in line with the aforementioned criteria, and does not respond to any commercial purposes.'

5.4.3. Used to implement or manage compliance with the explicit contractual restrictions (e.g. on P2P or VoIP)

Among citizens who responded, only 2.4% felt that measures 'to manage compliance with the explicit contractual restrictions (e.g. on P2P or VoIP)' were necessary, 11.2% felt that they were appropriate, and 85.9% felt that they were problematic.

On this question, network operators had (unsurprisingly) a dramatically different perspective from that of applications and content providers. Consumer advocates and other civil society organisations appear to be deeply troubled by limitations on Voice over IP (VoIP).

- **FICORA** (Finland): 'This could be appropriate if it is transparent ("explicit") but it could also be problematic, if non-restricted offers are not available. An open access to all services any time and anywhere for consumers and businesses should be an important policy goal.'
- **Technical Surveillance Authority of Estonia**: 'Generally we support the approach that internet connection should be as free of restrictions as possible, especially for VoIP and other widely used services. But if end-user accepts this and for example therefore gets a service with lower price then it is a question of user's choice.'
- **The European Telecommunications Network Operators' Association (ETNO)**: 'Appropriate. Where tariff portfolios contain products with restrictions or so called "optional tariffs" traffic management measures are necessary to ensure the terms of the contracts are respected. As long as the relevant transparency obligations are met and the market provides end-users with a variety of offers providing access to Internet content and applications of their choice, this is also appropriate'
- **The Voice on the Net (VON) Coalition Europe** (VoIP providers iBasis, Google, Microsoft, Skype, Viber, Vonage, Voxbone and WeePee): 'VON believes that the European Commission and BEREC should ensure that network operators are prohibited from creating barriers to entry to over-the-top players, ranging from blocking, throttling or charging for the fact that their services, applications or content runs over their network, while there is absolutely no evidence of free riding, quite the contrary, as the BEREC considers that "users at the 'edges' (i.e. subscribers and over-the-top players) of the Internet each pay for their own connections". More specifically, from VON's perspective, the fact that some network operators ask subscribers to pay a surcharge to use VoIP applications on mobile phones is a clear abusive practice, notably when considering that: (1) subscribers and content and application providers have both paid for their use of the network and (2) many of the VoIP applications are actually available for free or at a minimal charge. VON would like to emphasise the following points:
    - There is no reasonable traffic management justification to block or hinder VoIP traffic or ask for a surcharge, and hence such practices should be explicitly prohibited by the BEREC and its members as clear examples of

'distortion of competition'. We note that instant messaging is already in line to be subjected to the same type of discriminatory treatment, as evidenced by the announced intention of WhatsApp in the Netherlands (which led to the adoption of net neutrality legislation) and statements such as the one made by AT&T's CEO in 2012: "Apple iMessage is a classic example. If you're using iMessage, you're not using one of our messaging services, right? That's disruptive to our messaging revenue stream".

- Moreover, as VoIP is particularly sensitive to degradations in network performance (especially in terms of latency requirements), and because of its reliance on peer-to-peer (P2P) protocols in some cases, it can be faced with various network management impediments put in place by ISPs. Additionally, because the predominant VoIP protocols used today all generate P2P traffic (including SIP, H.323, and Skype's own P2P protocol among others), they are at risk of being blocked or degraded as a result of blanket anti-P2P measures imposed by operators, even though they do not inherently involve file transfers or intellectual property issues. … VON considers that an application agnostic approach can function if it is the user that decides, and not the ISP acting as a gatekeeper.'

- **Die österreichische Bundesarbeitskammer**: 'Internettelefonieangebote (VoIP), die Sprachkommunikation über das Internet ermöglichen, haben sich breit etabliert. Für herkömmliche Kommunikationsdienstleister, die sowohl Internet- als auch Telefoniedienste anbieten, bedeutet dies unliebsame Konkurrenz, die auszuschalten versucht wird. Die Verbraucherorganisation BEUC hat bspw erhoben, dass in Großbritannien bereits 2007 Telekombetreiber das VoIP-Protokoll aus Nokia-Handys entfernt haben - ein Versuch sich lästiger Mitbewerber zu entledigen. Auch in Deutschland habe es bereits Ankündigungen eines großen Internetbetreibers gegeben, die Verbindung zu Skype zu unterbinden. In Frankreich sei irreführend für „unlimitiertes" mobiles Internet geworben worden, obwohl bestimmte Dienste (bspw VoIP, peer-to-peer Netzwerke) vorab blockiert worden sind.'

- **BEUC**: 'Restrictions on what users can do with their Internet connection, whether enforced technically or on the basis of a contractual obligation, should never be allowed in order to fully respect the neutrality of the Internet. Even more so when the restrictions are not technologically or application-agnostic and directly target a specific application or service such as P2P or VoIP. There should also be a clear distinction between traffic management that is done without the user's consent or precisely because the end user wishes so. Further, even when traffic management is done with consumers' consent, it is important to highlight that the rules on fair and transparent contract terms continue to apply, and that contracts must therefore not contain complex, confusing language.'

5.4.4. Targeting types/classes of traffic contributing most to congestion

Among citizens who responded, only 3.3% felt that measures 'targeting types/classes of traffic contributing most to congestion' were necessary, 13.9% felt that they were appropriate, and 82.8% felt that they were problematic.

Views roughly parallel those on managed services in general; some consumer advocacy organisations viewed these practices as particularly troubling.

- **FICORA** (Finland): 'Traffic management to route traffic optimally and to apply priorities to traffic flows is understandable particularly in mobile broadband networks and acceptable in order to ensure quality and fair service usability for all users.

Targeting traffic management to traffic contributing the most to the congestion shall be used in a transparent way and with no application-specific restrictions. Spam and attack traffic generated by viruses and malware are the most common examples of situations where this kind of action would be necessary.'

- **The European Telecommunications Network Operators' Association (ETNO)**: 'As long as transparency obligations are met, this is to be considered appropriate. Whether such measures are necessary depends largely on available capacities. In the mobile context, for example, such measures are necessary, because capacity is strictly limited by the availability of spectrum. Such measures could be deemed inappropriate if they were carried out in an non-transparent manner for anti-competitive purposes. Fierce retail competition in Europe's broadband markets and strengthened transparency obligations make such a scenario highly unlikely in the EU.'
- **Deutsche Telekom**: 'As long as transparency obligations are fulfilled, this is to be considered as appropriate. Whether such measures are necessary depends largely on the available capacities.'
- **Vodafone**: 'This is the case of throttling of P2P traffic that is used normally only in case of congestion or within fair usage polices (i.e. when customers with unlimited data plans use an amount of traffic well above the normal user). Throttling involves slowing down IP traffic to a low speed (e.g. max 64-128 Kbps). The decision to throttle P2P traffic – rather than throttle all applications - is driven by several considerations including the fact that P2P is the application least sensitive to delay and because P2P is peculiar in the use of bandwidth as it starts multiple TCP or UDP parallel connections. This means that a single P2P user consumes much more bandwidth when compared to users of other applications within the same mobile cell. If application agnostic restrictions were applied, the P2P user would continue to have assigned a much higher cumulative bandwidth than other applications. We consider this unfair to other users. The relevance of P2P limitations has decreased as operators have moved from unlimited data plans to plans with tiered data caps in most European markets. This has removed the incentive for some customers to consume abnormally high amounts of data, usually for P2P applications. Initiatives by regulators to confront copyright infringement have also affected P2P volumes in some markets (P2P was the application most commonly used to distribute illegitimately reproduced content).'
- **BUGLAS** (German association fibre-optic networking): ‚Die höheren Qualitätsanforderungen bei der Übertragung bandbreitenintensiver Dienste sind für den Betreiber jedoch auch mit höheren Kosten verbunden. Es gilt zu verhindern, dass Endkunden, die lediglich gering anspruchsvolle Dienste wie E-Mails in Anspruch nehmen, für das bandbreitenintensive Nutzungsverhalten anderer Endkunden bezahlen.'
- **The European Broadcasters' Union (EBU)**: 'These measures are problematic because of the risk that ISPs could use these to degrade the user experience of Over The Top (OTT) video content in order to encourage users towards using their own managed services. The EBU does not believe that traffic management based on traffic classes are the solution to deal with network congestion. Investment in additional capacity and advanced technical solutions for efficient traffic delivery should go hand to hand. In so far as traffic differentiation practices are based on concerns over network congestion, maintaining these practices also act as a disincentive for network investment." 5e."These practices cannot be imposed at the full discretion of the ISP and can only be an appropriate measure towards those

users that violate the conditions of their subscription contracts. A key prerequisite is that contracts clearly state what the agreed limits in terms of available bandwidth or amount of data are. ISPs should ensure that normal use in accordance with the subscription contracts does not lead to network congestions, including in the peak time.'

- **BEUC**: 'Traffic classes raise concerns because they create incentives to degrade the best effort Internet in an anti-competitive manner and represent an eventual departure from this model of the Internet. Operators seem to have had the possibility to offer them for over a decade and yet have not decided to do so before. There is no sufficient justification for this paradigm shift in the way networks are operated and therefore we see no reason why the best effort approach should be abandoned. As stated above, a best effort internet without illegitimate interference and discriminatory practices from ISPs results in a high quality of experience for consumers and has offered the right platform for great innovation over the past decades, and should therefore not be undermined by introducing traffic classes.'

5.4.5. Targeting heavy users whose use is excessive to the extent that it impacts on other users

Among citizens who responded, 5.2% felt that measures 'targeting heavy users whose use is excessive to the extent that it impacts on other users' were necessary, 19.5% felt that they were appropriate, and 75.3% felt that they were problematic.

- **FICORA** (Finland): 'If traffic management is targeted to heavy users, it shall be mentioned explicitly in the contract, so that the user understands that there will be limitations of traffic volume in certain time period. Heavy use itself should not be a cause for traffic management actions directed to certain customers as long as the traffic is in line with the general terms and conditions of the product. The lack of transparency in contracts is likely to be a problem.'
- **Deutsche Telekom**: 'By including volume caps in the terms and conditions of the contracts we protect the vast majority of our users who will not get close to the specified monthly allowance with their usage pattern. In essence we make sure, that there is no "cross subsidy" from the average to the heavy user.'
- **The European Telecommunications Network Operators' Association (ETNO)**: 'Necessary and appropriate. As far as Fair Use Policies are concerned, the measure is appropriate to target heavy users in line with contractual provisions. These policies are indispensable to ensure a fair access for all customers by targeting exceptional cases, for example the case of an end-user who uses his connection as a permanent download link. Other measures are currently not used to specifically target heavy users.'
- **Vodafone**: 'In the early stages of mobile internet development, mobile operators, including Vodafone, launched pricing plan with unlimited data. These pricing plans have led to the unintended consequence of having a few customers using a substantial share of the available network capacity. Network performance for the remaining customers is substantially affected. As described in the answer to question 5.d, operators have responded by activating the "Fair Usage Policies" contained in the terms and conditions to make sure that usage by a limited number customers did not affect service to the rest of the customer base. This is usually done by throttling (for a limited period of time) data traffic over defined threshold considered normal for high data users. Traffic management is used to implement

fair usage policies that are necessary to maintain a good service for the whole customer base.'

- **Computer and Communications Industry Association (CCIA)** (an association including content providers and network operators): 'Allowing users to choose a subscription with a relevant bandwidth cap is the appropriate response rather than specifically targeting heavy users.'
- **Association Bordelaise des Utilisateurs de Logiciels libres** (association of application providers): 'Si l'on peut imaginer une offre tarifaire différenciée selon le débit maximum offert, la péréquation doit être effective entre usagers appartenant à la même classe. Des utilisateurs individuels ne peuvent être discriminés. Cela supposerait une analyse de leur trafic, en violation de leur vie privée.'

5.4.6. Applied during busy times and places, when and where congestion occurs

Among citizens who responded, 5.6% felt that measures 'applied during busy times and places, when and where congestion occurs' were necessary, 26.7% felt that they were appropriate, and 67.7% felt that they were problematic.

- **BEREC**: 'BEREC has acknowledged that ISPs should have the opportunity to manage their networks to increase efficiency, minimising the resources needed to provide the service and assuring the best deal to all end users. It is important to note that congestion has some hidden costs that are difficult to measure, as it affects all end users connected to the network. In this sense, a fair TM could be welfare enhancing. These arguments are valid only if the restrictions are done on a non-discriminatory basis among all CAPs, and using objective criteria such as consumption of resources. In other cases, the rationale behind the ISPs' behaviour could be distortion of competition.'
- **The European Telecommunications Network Operators' Association (ETNO)**: 'Necessary and appropriate: in order to preserve the integrity and the optimal performance of the network and in order to guarantee the access for all the users and to all the applications such measures are necessary and appropriate.'
- **Deutsche Telekom**: 'Traffic management measures are both necessary and appropriate to deal with congestion when and where it occurs. This is necessary to assure network stability and improves the customer experience.'
- **Which?** (consumer advocacy): 'As highlighted above, traffic management use to solve temporary situations of network congestion is reasonable. Traffic should be managed locally, only when the congestion occurs. The traffic management measures should be immediately removed as soon as the congestion has been resolved.'

5.4.7. Affecting all applications/content providers in the same way (application-agnostic)

Among citizens who responded, 25.1% felt that measures 'affecting all applications/content providers in the same way (application-agnostic)' were necessary, 38.2% felt that they were appropriate, and 36.7% felt that they were problematic. Among citizens, this was the approach that was perceived as least problematic.

- **BEUC**: 'Traffic management always needs to be application-agnostic, in order to ensure a non-discriminatory treatment of different types of applications and content, thus protecting the neutrality of the Internet.'

- **Verbraucherzentrale Bundesverband**: 'Traffic management always needs to be application-agnostic, in order to ensure a non-discriminatory treatment of different types of applications and content, thus protecting the neutrality of the Internet.'
- **Which?** (consumer advocacy): 'Traffic management should be application-agnostic, to ensure non-discriminatory treatment of applications and content.'

5.4.8. Used against services competing with the ISP's own services

There was nearly universal agreement that traffic management employed, without other grounds, against services competing with the ISP's own services is problematic. (See also Section 3.2, which deals with the economics of vertical foreclosure.)

Among citizens who responded, 2.1% felt that measures 'used, without other grounds, against services competing with the ISP's own services' were necessary, 1.8% felt that they were appropriate, and 96.2% felt that they were problematic.

A sampling of relevant responses on economic foreclosure:

- **BEREC**: 'Vertical integration gives incentives to ISPs to implement differentiation practices, as they could reduce competitive pressure on their own retail services. The paradigmatic example of this is VoIP; ISPs provide voice calls through the traditional fixed or mobile network, while end users could find substitutes on the Internet (maybe no perfect substitutes but at least viable substitutes for some types of calls) at lower prices (even for free). Indeed, this practice is one of the most widespread according to the data gathered by BEREC. As this differentiation has the aim of foreclosing, the effects on end users are high because these practices have both static and dynamic effects. The less the competition, the higher the prices and, in addition, restrictions on CAPs could have the effect in the long run of limiting their growth by reducing their potential demand.'
- **FICORA** (Finland): 'Traffic management shall not be used to restrict competition or for anticompetitive reasons.'
- **BUGLAS** (German fibre-optic association): 'Der Bundesverband Glasfaseranschluss e.V. (BUGLAS) vertritt die Auffassung, dass alle Internetnutzer im Web angebotene Dienste in dem Sinne diskriminierungsfrei in Anspruch nehmen können, dass eine willentliche willkürliche Behinderung des Zugriffs auf Anwendungen und Dienste seitens der Netzbetreiber ausgeschlossen ist.'
- **Which?** (consumer advocacy): 'This type of traffic management is commercially-driven and hinders competition within the service being blocked. This has a detrimental effect on end-users whose choice between competing services is diminished. This type of traffic management should never be used.'

5.5. Threats and opportunities for new services

Preserving the potential for innovation was of great importance to all stakeholders; however, there were noteworthy differences in emphasis as to the nature of likely innovation, and consequently as to the nature of measures that might serve to preserve the prospect of those innovations.

- **Vodafone**: 'Traffic management systems allow operators to perform a number of activities. Each one of them will have positive effects on the Internet ecosystem: (1) Reduce/prevent congestion; (2) Better service for all customers leading to more applications and services; (3) Optimise network investment - price differentiation (prioritised access, VoIP inclusion/throttling, data caps, etc.); (4) Price innovation;

(5) Better value for money; (6) Price structure closer to customer needs leading to higher mobile internet penetration; (7) Application innovation (i.e. QoS requirements related to some applications) - Protect general users (block viruses, malware, spam); (8) Safer internet leading to higher penetration; (9) More resilient networks - Protect minors (e.g. content filtering), Optimise user experience (image/video optimisation, web caching), Implement legal requirements. Among those mentioned above, differentiation practices on the application side (e.g. prioritisation) have been subject to more discussion within the Net Neutrality debate. Again we believe that the practices described above do not generate competition issues requiring prescriptive regulatory measures. If prioritisation is offered to all interested parties on the same terms, we believe that there should be no competitive concerns (i.e. potential unfair advantage to a Content and Application Provider - CAP compared to its competitors). We agree, however, that a vertically integrated operator that competes with the CAP gives rise to particular concerns, but these can be addressed by straightforward non-discrimination rules.'

- **Cisco Systems**: 'The essence of traffic management is to provide a better consumer experience. The growing demands placed on broadband networks threaten the user experience and the value of the network, and enhanced network management offers a viable, intelligent and tailored means of addressing those demands. Clearly, operators should not be allowed to block or degrade any lawful traffic in a way that harms competition or consumers, and network management techniques should be reasonable, and not be used in an arbitrary way. At the same time, management tools should allow for differentiation and innovative business plans'
- **Computer and Communications Industry Association (CCIA)**: Traffic management by ISPs that discriminates between services it offers and those of another firm has negative effects. Such discrimination would cause immediate damage to the interests of online service providers, and signals that behaviour of this type is tolerated, would have a chilling effect on the Internet ecosystem. Any decisions about traffic management by a network provider should be independent of its upstream interests.'
- **Which?** : 'Since its inception, the internet has been an open platform fostering innovation without permission, and has granted consumers access to a growing amount of content and knowledge. It has connected people like no technology has ever done before. This has only been possible due to the open and neutral character of the Internet, where no technology, service or content was discriminated against without a legitimate reason. Preserving net neutrality will allow for continued growth in the internet sector, driving the economy forward. Which? is concerned that discriminatory use of traffic management could force technological innovators to shape new products to meet myriad variable, uncertain regimes, discouraging the development of new technologies and services.'

5.6. Privacy and Deep Packet Inspection (DPI)

Not all forms of traffic management depend on Deep Packet Inspection (DPI). As Deutsche Telekom noted, for instance '… most traffic management measures do not rely on DPI. Packet Inspection [i.e. of headers only] and standard router functionalities are absolutely sufficient to produce traffic statistics and analysis and to prioritize IP traffic in case of congestion.'

The European Data Protection Supervisor provided a clear assessment of the use of DPI. 'ISPs are entitled to develop traffic management practices, provided that they are fully respectful of privacy and data protection requirements. … under the ePrivacy Directive ISPs may usually carry out this type of processing [i.e. analysing source and destination IP addresses and Internet protocol] for purpose of conveying the communications, safeguarding the security of the communications service, or minimising congestion.'

The EDPS response goes on to note that for 'behavioural analysis and profiling, mainly used for security purposes but also for commercial, copyright and other uses', there is a question as to whether the processing operations are necessary and proportionate to the aim pursued, and whether they have a sufficient legal basis under Directive 95/46/EC; if not they should be based on another legal ground, such as consent. The large amounts of data gathered could be used for new purposes e.g. for economic or law enforcement purposes. Scanning packet payloads is a high risk activity in terms of possible impact on privacy and data protection; consequently, technical and organisational safeguards must be strong and effective.

Different stakeholders saw different threats and opportunities in DPI. The European Broadcasters Union (EBU) was concerned about the possible risk to freedom of expression: 'DPIs are a form of filtering (surveillance) of Internet packages and content. They can be used for legitimate purposes such as, security, combating piracy and illegal content (i.e. child pornography), however they can also be detrimental to the protection of privacy and personal data (i.e. by monitoring of users' on-line activity for commercial advertising purposes, for example) and could be used by certain countries as a means of censoring the Internet. Through the use of these traffic management techniques, the network operators and ISPs should not take on the role of policing or controlling/monitoring the Internet usage.'

Vodafone notes that DPI is often used for pattern analysis, not necessarily for inspecting the actual content of user data. 'To facilitate comprehension of how these analytical tools work, think of a comparison with hieroglyph. These analytical tools are like Egyptologists before the finding of the Rosetta Stone: they could recognise an inscription as being ancient Egyptian, but they could not understand the meaning.' They then acknowledge that the '… use of traffic management technologies for varying purposes naturally raises privacy concerns. Depending on the purpose for which the technology is used, there is the danger of mission creep (the danger of data captured being used for other purposes for which it was not originally intended). However, traffic management measures are legitimate, beneficial to our customers and are also necessary, justified and appropriate in a variety of operational and commercial circumstances as described in the previous answers. We recognise that operators need to properly and robustly control and govern such practices.'

There was broad consensus that DPI potentially raises privacy concerns, but some differences as to the assessment of the implications.

- Consumer organisations are clearly concerned. BEUC noted: 'In addition to net neutrality, the use of DPI techniques raises serious privacy concerns, because it can involve the inspection of information sent from one end user to another. DPI technology has the capability to look into the content of messages sent over the Internet, thus enabling third parties to draw inferences about users' personal lives, interests, purchasing habits and other activities. This gives ISPs and other organizations widespread access to vast amounts of personal information sent over the Internet.'
- Some network operators argued that they followed EDPS guidelines, and that these risks were already mitigated. Others such as Vodafone argued that any DPI-related

risks were manageable if network operators exercise due care: 'the suggestion that customers should be asked to consent to the use of traffic management for purposes that seek to deliver a secure, confidential, and quality service to customers is not correct. In our opinion, any privacy concerns regarding the uses of DPI for traffic management purposes can be managed by robust accountable business practices and controls; and by providing customers with transparency surrounding the use of network traffic management technologies.'

- Some content and application providers argued that the use of DPI was unnecessary and harmful. VON Europe (a group of VoIP providers), for instance, argues that '[t]raffic management as handled by operators in the past and which was motivated solely by the concern to manage congestion in an efficient and non-discriminatory manner does not require DPI type techniques, as packets have been built in a manner that allows networks to spot the necessary information without needing to dig deeper. DPI only comes into play when discriminatory practices that aim at differentiation not between e.g. a video stream and email but between which video streams are used.'

5.7. Interconnection, QoS, and Content Delivery Networks (CDNs)

Nearly all stakeholders argued that IP-based interconnection should continue to be governed by commercial negotiation rather than regulation; some incumbent network operators, however, expressed concerns over alleged imbalances between content providers and ISPs.

- **BEREC**: 'BEREC noted in its response to the Commission that interconnection arrangements between networks are not directly related to net neutrality as long as all traffic flows are treated equally. A violation of the net neutrality principle is, therefore, considered unlikely if all traffic is treated in a best effort manner. The best effort principle is reflected in today's interconnection agreements across IP networks. Interconnection on the Internet has operated on the basis of transit/peering arrangements at the higher level and a 'bill & keep' approach whereby the terminating access network operator does not receive payments at the wholesale level for terminating the traffic, but recovers its costs at the retail level from the end user. Nowadays, QoS differentiation potentially leading to deviations from net neutrality typically occurs only within the ISP's network providing connectivity to the user and, therefore, is not reflected in interconnection agreements across networks at the network layer. Over the Internet, a guaranteed end-to-end QoS across network boundaries does not appear to be realistic in the near future.'
- **The European Telecommunications Network Operators' Association (ETNO)**: 'ETNO supports commercial agreements along the value chain for IP Interconnection. We do not call for regulation of IP Interconnection markets by national regulators, the European Commission or other bodies. However, ETNO has expressed repeatedly its concern over a current imbalance in the internet value chain. In the field of IP Interconnection asymmetric traffic flows in many cases are not compensated through payments. While peering arrangements work fine between "peers" that transport roughly equal amounts of traffic the massive increase in particular of video traffic has created persistent imbalances that require a new equilibrium between network operators and content and application providers that reach end-users over the network. Adequate commercial arrangements – for example compensation based on specific quality of service or the value of the traffic - should be facilitated by a light-touch regulatory policy that does not

asymmetrically burden one part of the internet value chain, namely access network operators.'

- **European Broadcasters' Union (EBU)**: 'IP interconnection agreements have developed so far without any significant regulatory intervention. Today's arrangements reflect the best effort principle and have so far been crucial for the Internet's contribution to growth and innovation and for end-users to reach all destinations on the Internet. Public service media (PSM) acknowledge this: it is reflected in their engagement to secure the delivery of their content to the end-user with a range of intermediaries and in the fact that they pay for hosting, connectivity and CDNs. Specific attention needs to be paid to the case where an ISP that predominantly sells connectivity to content and applications users at retail level ("Eyeball ISP") deploys its own transit capacities and long distance networks. In some cases, such an ISP has such a comprehensive network that it never needs to purchase transit agreements from other providers ("Tier 1 provider"). In this case, the Eyeball ISP's market power increases at the interconnection level and provides the opportunity to use traffic management or even block traffic in order to pursue its own commercial interests at the expense of services competing with the ISP's own services.'
- **Vodafone**: 'The IP interconnection market is currently functioning well in the absence of regulation. The presence of different, competing methods of IP-interconnection – transit, peering, content distribution networks (CDNs)/caching - constrains the behaviour of market participants and reduces the potential for market power. Regulators should not focus on whether market players that previously had market power in the telephony world (network operators) will have market power in the IP world.'
- **The Voice on the Net (VON) Coalition Europe** (VoIP providers iBasis, Google, Microsoft, Skype, Viber, Vonage, Voxbone and WeePee): 'The OECD and BEREC pointed out in a joint 2011 Report on peering75 that the peering market is efficient and competitive. … The discriminatory practices put in place by some operators can have a rippling effect across the network, and are likely to be especially present in case of vertical integration.'

Numerous responses acknowledge that Content Delivery Networks (CDNs) play a constructive role, accelerating the delivery of traffic, reducing the distance that traffic must be carried in the Internet, and thus alleviating congestion.

A few potential concerns were raised, especially where a vertically integrated network operator also provides a CDN, but none of the comments that we referred indicated immediate, serious concerns.

- **Akamai** (provider of a global Content Delivery Network (CDN)): 'Thanks to CDNs, traffic and hops can be significantly reduced, thus reducing "long distance" traffic and congestion across the Internet.'
- **Cisco Systems**: 'CDN helps to reduce traffic in the aggregation and core segments of a network by storing content closer to the access network. Thus, congestion situations in those parts of the network can be effectively mitigated. However, CDN is no remedy for under-dimensioned access networks. It is vitally important to modernize access networks, both wireless and wireline to keep pace with the evolution of bitrate requirements.'

- **Computer and Communications Industry Association (CCIA)**: 'Content Delivery Networks allow services maximise efficiency and quality, but only up to the exchange point. Their role is important in the consumer experience.'
- **The European Broadcasting Union (EBU)**: 'In its draft report "An assessment of IP-interconnection in the context of Net Neutrality", BEREC concludes that there are different alternative mechanisms in the best efforts networks for improving end-to-end network performance (and therefore the QoE), including CDNs … The EBU very much welcomes this. In our view, congestion at interconnecting hubs is generally best prevented by caching popular content as deep as possible in the network. Other techniques that will help to do this are Open and Transparent caches and/or the possibility for CAPs to co-locate caches in third party networks. Whereas we agree that the content providers' scale influences the decision to buy or make CDN services, it does not necessarily imply that operating its own CDN would only be interesting for a global content provider. CAPs which mainly operate locally, such as public service media in a specific country or language domain, often have more/better peering relationships with local ISPs than global CDNs have. In that situation, a global CDN does not deliver interconnection advantages. This could make the scenario viable in the future for such a broadcaster to use their own CDN. At the same time, public service media in larger countries do not necessarily have more interconnections with ISPs than the global CDNs. They already use different CDNs to offload their content, optimising data flows by directing traffic to the CDN that has the best capacity at that moment in time. In these markets CDN-Overlays and CDN-Federations will become more important in the future.'
- **BEUC**: 'In principle, Content Delivery Networks (CDNs) allow for a better Quality of Experience for consumers. They allow for the replication of content and reduce the total network distance which content must travel to reach the end-point. It is important to note though that caching comes with risks. It is very important that consumers always get up-to-date content when they are accessing mirror servers and therefore caching needs to be done in a way that all content is always updated downwards to the CDN's servers." 25b: "CDNs also present challenges and risks from a consumer perspective. Where providers of CDNs integrate vertically into network providers and ISPs and also provide their own content and applications, they can actively discriminate among traffic by favouring and prioritising their own content, which is in violation of the principle of net neutrality. Therefore CDNs need to work in a content-agnostic manner, providing the content of their business partners in a non-discriminatory way.'

5.8. The risk of divergent interventions among the Member States

There was a broad consensus among stakeholders that divergent interventions at Member State level could be problematic. This would appear to be highly relevant to any discussion of the relevance of the principle of subsidiarity to possible actions at European level. At the same time, the issue may have greater salience to market players than to consumer advocates or to residential consumers.

- **The European Telecommunications Network Operators' Association (ETNO)**: 'Divergent intervention would risk creating distortions in the single market and in a global market for the provisioning of internet based services. ETNO invites the Commission to act in a decisive manner under the EU Treaties against legislation aimed at preserving 'net neutrality' but de facto undermining the development of differentiated service offers and/or new business models, as well as regulatory measures at national level with the same effect.'

- **Deutsche Telekom**: 'Divergent intervention would risk to create distortions in a global market for the provisioning of internet based services. It would also create uncertainties with regard to the legality of business practices for all undertakings that operate in several member states. This in turn would raise costs and further disadvantage European players versus their US competitors in the global market place.'
- **Vodafone**: 'A divergent approach will put at risk the internal market for internet services, undermine innovation and reduce investment. For example, a content provider operating on a EU-wide scale will be able to offer a product based on prioritised QoS in some countries and not in others.'
- **Cisco Systems**: 'Divergent interventions by public authorities in the EU Member States risk creating distortions in the digital single market and in the global market. The Commission should monitor closely national implementations of the open internet provisions in the EU Telecoms Framework and oppose national regulatory measures that could undermine the provision of differentiated service offers and new business models in the internet.'
- **European Broadcasting Union (EBU)**: Any policy intervention in the field of net neutrality should be to safeguard an open and neutral internet. Divergent interventions by public authorities in the EU could lead to a situation where a digital divide arises between different Member States.'

5.9. The path forward

Stakeholders expressed varied views. BEREC and NRAs generally advocated a wait-and-see attitude, coupled with monitoring of developments; some (not all) consumer advocates and some content and application providers called for urgent action to address abuse. Some network operators sought action at European level primarily in order to mitigate the risk of divergent actions at Member State level.

- **BEREC**: 'Public authorities should have the capacity to intervene, given the important challenges at stake in the net neutrality debate. However, regulation should not be unnecessarily intrusive, since flexibility appears indispensable in such a fast-changing environment. In this context, BEREC has stated that regulators would stand ready to act if necessary. Evaluating the conditions leading to such a necessity, and the type of action to take in that case, has been at the core of BEREC work streams on net neutrality, since its response to the 2010 Commission's consultation on net neutrality and the open Internet. A preliminary assessment from BEREC, then, was to consider the framework issued from the 2009 review a priori sufficient to address most of the identified net neutrality-related concerns. *BEREC considers that these powers and tools can usefully address many of the concerns that have been expressed in the context of net neutrality to date.* [Under the various national transpositions of the 2009 framework,] NRAs have been entrusted with a general objective of promoting the access to content, and additional powers to implement enhanced transparency, on the one hand, and of monitoring QoS, on the other hand – which is generally also accompanied with the possibility of setting minimum quality requirements. There is, however, a certain heterogeneity between Member States in the modalities available to exert those powers.'
- **FICORA** (Finland): 'In principle, there is no need for regulation by public authorities. Strict regulation would delay innovations and development of the Internet. The Internet will develop faster and more flexibly on market than through

regulation. However, if intervention is really necessary, public authorities should primarily aim at giving general guidelines.'

- **The European Telecommunications Network Operators' Association (ETNO)**: '[T]here is no need to intervene in the competitive markets for retail broadband access or for IP connectivity.'
- **The European Competitive Telecommunications Association (ECTA)**: '[A] self-regulation approach should be firstly promoted. Additional guidance on net neutrality should be deemed to be necessary only if self regulation fails. In this respect, ECTA believes that regulators may play a significant role in facilitating and incentivising effective self regulation. … Business service providers providing bespoke offers to high-end businesses and administrations should be excluded from the scope of any NN measure. Strict transparency measures would not be suited for high-end business users negotiating bespoke offers from operators for which the required QoS conditions are mutually agreed in the contract negotiation phase.'
- **European Broadcasting Union (EBU)**: 'Any policy intervention in the field of net neutrality should be to safeguard an open and neutral internet. … It is important that a robust Internet best-efforts access is available for all EU citizens regardless of their Member State of residence. Furthermore, we need to ensure a consistent effective implementation of the EU "Telecoms" regulatory framework by all EU Member States.'
- **Computer and Communications Industry Association (CCIA)** (representing both ISPs and application providers): 'The ongoing uncertainty over telecoms operators ability to discriminate against services that compete with their own creates a chilling effect for potential investors and innovators. Given the economic situation this is a disincentive that we can ill-afford. To create a stable framework the CCIA believes that the European Commission should:
    - Issue a Recommendation clarifying existing legislation in relation to the open Internet
    - Describe what the "best efforts" Internet looks like and below what level it should not fall
    - Describe what it sees as reasonable and unreasonable network management practices
    - Encourage National Regulatory Authorities to monitor traffic management practices in an ongoing fashion (to avoid sudden and arbitrary changes).
    - Encourage the development of codes of practice in conjunction with ISPs as to reasonable network management (examples from UK, Norway, Japan and others) and based on the EC's views of what constitutes 'reasonable' and 'unreasonable' network management.
- **BEUC**: As BEREC's findings show, net neutrality is being constantly violated throughout Europe, in fixed and mobile markets alike. Recommendations and guidance given by the European Commission or BEREC and NRAs may provide some partial solutions, but they also represent a risk that the necessary binding legislative solutions are further delayed. Leaving the situation to competition will not guarantee that net neutrality is protected as a key principle of telecommunications legislation and will not provide a legal basis for courts to work on in case of related litigation. It is therefore of crucial importance that, on issues that have not been already covered by current legislation, the European Union adopts a new, binding legislative

instrument to restore and protect net neutrality as a matter of urgency. In order to ensure legal certainty, it is of utmost importance that certain key concepts are well defined. These definitions, together with a clear list of consumer rights related to net neutrality and a set of prohibited discriminatory activities for telecoms operators, should be the backbone of any legal instrument adopted to protect net neutrality. Establishing clear, well-defined concepts such as 'public Internet' or 'best effort Internet', 'managed services' and 'legitimate traffic management measures' are important to ensure all implementation measures at Member State level are coherent and there is clear legal certainty for consumers across the EU. Regarding the implementation of existing transparency provisions in the telecoms package, encouraging industry to implement co-regulatory approaches after agreeing on standards may be a useful first step in some countries. A co-regulatory approach offers flexibility and speed to adapt to market and technological developments. Further, the diversity of the stakeholders involved may favour the development of practical solutions. However, it should be ensured that any such initiative is compulsory for all ISPs and mobile network operators, has independent oversight, monitoring and complaint handling mechanisms, redress and sanctions. …'

- **Verbraucherzentrale Bundesverband: '**As BEREC's findings show, net neutrality is being constantly violated throughout the European Union, both in fixed and mobile markets alike. In order to ensure legal certainty, it is of utmost importance that certain key concepts are well defined. These definitions, together with a clear list of consumer rights related to net neutrality and a set of prohibited discriminatory activities for telecoms operators, should be the backbone of any legal instrument adopted to protect net neutrality. Establishing clear, well-defined concepts such as what are 'legitimate traffic management measures' are important to ensure all implementation measures at Member State level are coherent and there is clear legal certainty for consumers across the EU.'
- **Which?** (consumer advocacy): 'Although leaving the situation to market competition will not guarantee that net neutrality is protected, industry should first be given the chance to implement competitive behaviour and restore net neutrality. As a first step in intervention by public authorities industry could be encouraged to implement a self-regulatory approach after agreeing standards. In the UK for example, the Broadband Stakeholder Group, an advisory group on broadband issues comprised of relevant industry, regulatory and governmental figures, has put forward voluntary codes on traffic management and transparency. While these codes are still in their infancy and under development, a self-regulatory approach may be favourable to legislation due to the flexibility and speed with which it can respond to market and technological developments. Furthermore, the diversity of the stakeholders involved may favour the development of practical solutions. However it should be clear to industry that where self-regulation is not fit for purpose and does not bring about any meaningful, positive change for consumers, NRAs will step in and introduce regulation.'

6. DIFFERENCES BETWEEN THE US AND THE EU

KEY FINDINGS

- The US regulatory approach to network neutrality that is likely to emerge shortly responds to different circumstances than those relevant to Europe. The overall US regulatory approach is partly a cause, and partly a response, to a very different marketplace.
- Most US homes are able to receive broadband from either a cable television provider or a telecommunications provider; however, deregulation has resulted in the disappearance of competitive providers (using LLU or shared access) in the US, resulting in a market environment that is essentially duopolistic.
- The same deregulation makes it difficult or impossible for the FCC to take action on network neutrality, which is perhaps more worrisome in the US than in Europe due to the duopoly nature of the market.
- The FCC's new 2014 Open Internet proceeding seeks to reinstate network neutrality protections that were put in place in 2010 but invalidated by the courts.
- Many European homes are served by only a single fixed telecommunications network operator; however, many Europeans nonetheless have the opportunity to be served by any of a number of broadband providers thanks to a regulatory framework for last mile fixed network access in Europe (based on LLU, shared access and bitstream) that is generally effective.
- The richer competitive market structure in Europe, together with a more robust regulatory and competition law environment, has likely contributed to the low level of network neutrality incidents that have been observed in Europe to date.
- Experience with network neutrality legislation outside of Europe and North America is inconclusive to date. In Chile, there have been claims that the legislation enacted in 2010 has negatively impacted the use of mobile Internet services. In Brazil, it is too soon to judge the effects of the legislation enacted in April, 2014.
- The European Commission's decision to include network neutrality as part of the Telecoms Single Market Regulation was apparently inspired by concern over a possible proliferation of potentially inconsistent or incompatible legislation at Member State level (as enacted by the Netherlands in 2011, and by Slovenia in 2013), not by concerns that the NRAs lacked authority to deal with network neutrality issues (see Section 6.1.2).

Network neutrality issues have been far more visible in the United States than in Europe, and the remedies that the US FCC has sought to impose are more stringent than those in place in Europe. Is the US right? Is the European Union right? Or are both responding to different market and regulatory realities, in the context of different underlying institutional structures?

Experience with network neutrality legislation outside of Europe and North America is inconclusive to date. In Chile, there have been claims that the legislation enacted in 2010

has negatively impacted the use of mobile Internet services.[130] In Brazil, it is too soon to judge the effects of the legislation enacted in April, 2014.[131]

Section 6.1 summarises the US regulatory environment as it relates to broadband generally, and network neutrality specifically, and compares it with that of Europe; Section 6.2 discusses marketplace issues, again comparing the US to the EU; Section 6.3 compares competition law in the US to that of the EU; and finally section 6.4 provides an overall comparison. We spend somewhat more time explaining US arrangements, and present them first, because we believe that European readers (our audience) will be less familiar with them.

6.1. Relevant regulation and legislation

The different market characteristics of the US, in comparison to those of Europe, are partly a cause and partly a consequence of differences in the overall approach to regulation.

6.1.1. Relevant regulation in the United States

The regulation of network neutrality needs to be understood in the context of the overall regulation (or lack of regulation) of the Internet and of broadband Internet access in general.

Regulation of electronic communications in the United States reflects a sharp dichotomy between two legal (not economic) classifications: *telecommunication services* and *information services*. Telecommunication services are subject to numerous regulatory obligations; information services were historically subject to few if any explicit obligations.

Core Internet services were always treated as information services, and thus largely unregulated; physical access to the Internet was, however, historically treated as a regulated telecommunication service. As long as this was the case, the US regulatory system worked more or less similarly to that which Europe adopted in 2002 -2003.[132]

Through a series of regulatory decisions taken in the years of the George W. Bush administration, the FCC classified Internet access when sold bundled with Internet service to be an information service, thus generally exempting it from regulation. No serious analysis of possible market power on the last mile was undertaken.[133]

This *laissez faire* evolution had two important consequences relative to the evolution of the network neutrality debate in the US First, it reversed any tendency of the US broadband market toward competition over incumbent ADSL lines and similar; second, it made it nearly impossible for the FCC to impose penalties on firms that violate network neutrality.

As noted in Section 6.2.1, ADSL lines provided by competitors peaked at just over 5% in 2003, and subsequently declined. Shared access was eliminated in 2003, together with LLU for fibre-based broadband Internet access.[134] LLU for copper-based access nominally

---

[130] Lauren Walker (2014), 'How is Net Neutrality Working for the Countries That Have It?', *Newsweek*.

[131] Reuters (2014), 'Brazilian Congress Passes Internet Bill of Rights'.

[132] J. Scott Marcus (2002), Federal Communications Commission (FCC) Office of Strategic Planning and Policy Analysis (OSP) Working Paper 36, 'The Potential Relevance to the United States of the European Union's Newly Adopted Regulatory Framework for Telecommunications,' July 2002, available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-224213A2.pdf.

[133] See for instance J. Scott Marcus, 'Is the U.S. Dancing to a Different Drummer?', *Communications & Strategies*, no. 60, 4th quarter 2005. Available at: http://www.idate.fr/fic/revue_telech/132/CS60%20MARCUS.pdf.

[134] US FCC (2003), In the Matter of Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers; Implementation of the Local Competition Provisions of the Telecommunications Act of 1996; Deployment of Wireline Services Offering Advanced Telecommunications Capability (better known as the Triennial Review Order, or TRO), adopted 20 February 2003, released 21 August 2003.

remains, but it alone appears to be insufficient – it is a single rung on the 'ladder of investment'.

Various forms of anticompetitive discrimination are prohibited under US law, notably in Sections 201 and 202 of the Communications Act of 1934 as amended; however, these sections are applicable to telecommunication service providers. When the FCC reclassified broadband Internet access as an information service, they rendered these obligations ineffective. At the same time, the FCC eliminated other non-discrimination obligations that had existed under a series of FCC rulings known collectively as the Computer Inquiries. Collectively, these actions meant that there was no longer a clear legal or regulatory basis for the FCC to take action against anticompetitive discrimination.

In 2005, the FCC issued an *Internet Policy Statement* that argued that '… consumers are entitled to access the lawful Internet content of their choice … [and] to run applications and use services of their choice …"; however, the FCC had never formalized this statement of principles into explicit rules. An FCC policy statement has no legal force – it is simply a statement indicating how the five current FCC Commissioners might view particular matters that might come before them. It does not even do anything to bind future Commissioners.

After a lengthy investigation, the FCC found that Comcast (a large cable television company, and the largest provider of home broadband Internet access in the US) had interfered with the ability of their broadband customers to access peer-to-peer applications such as BitTorrent. Comcast agreed to end the practice; however, they challenged the legal basis on which the FCC had ordered them to do so. Comcast argued that the FCC had acted improperly, first by enforcing a 'rule' that was not in fact a rule, and where the FCC had circumvented the normal bureaucratic safeguards; and second, that the FCC lacked authority to issue such a rule in the first place for an information service.

The court indeed found that the FCC had failed to demonstrate its authority, and therefore vacated (lifted) the FCC's order.[135] As a regulatory authority, the FCC is supposed to implement provisions of US law. It also has *ancillary authority* that enables it to craft new rules in support of explicit legal mandates, or to ensure that its actions in support of a legal mandate are not circumvented or made meaningless. In this case, the court found that the FCC had failed to tie its assertion of ancillary authority to any 'statutorily mandated responsibility.' The court thus found that the FCC's purported grounds were nowhere near sufficient.

The FCC spent many months looking for ways to reassert its authority over possible deviations from network neutrality.[136] The FCC finally issued an Open Internet ruling in December 2010,[137] claiming Section 706 of the Telecommunications Act of 1996 (which calls on the FCC to promote the availability of advanced services (presumably broadband) to all Americans) as a source of authority. The 2010 Open Internet Order can be viewed as an attempt to formally implement an expanded version of the Internet Policy Statement:

- **Rule 1: Transparency:** A provider of broadband Internet access service must publicly disclose accurate information regarding the network management practices, performance, and commercial terms of its broadband Internet access services sufficient for consumers to make informed choices regarding use of such services

[135] See Comcast vs FCC, United States Court of Appeals for the District of Columbia Circuit, argued 8 January 2010, decided 6 April 2010, No. 08-1291.

[136] See, for instance, J. Scott Marcus, "New Directions for U.S. Telecommunications Regulation? The Comcast decision and the 'Third Way'", presented at ITS Europe, Copenhagen, September 2010, available at: http://ssrn.com/abstract=1656570.

[137] US FCC, Report and Order, In the Matter of Preserving the Open Internet; Broadband Industry Practices; GN Docket No. 09-191, WC Docket No. 07-52, 23 December 2010.

and for content, application, service, and device providers to develop, market, and maintain Internet offerings.

- **Rule 2: No Blocking:** A provider of *fixed* broadband Internet access service, insofar as such person is so engaged, shall not block lawful content, applications, services, or non-harmful devices, subject to reasonable network management. A provider of *mobile* broadband Internet access service shall not block consumers from accessing lawful websites, subject to reasonable network management; nor shall such person block applications that compete with the provider's voice or video telephony services, subject to reasonable network management.
- **Rule 3: No Unreasonable Discrimination:** A provider of *fixed* broadband Internet access service, insofar as such person is so engaged, shall not unreasonably discriminate in transmitting lawful network traffic over a consumer's broadband Internet access service. Reasonable network management shall not constitute unreasonable discrimination.

A few observations are in order. First, we note that the Open Internet ruling attempted to rigorously define what constitutes 'reasonable network management'; nonetheless, had the order been sustained by the courts (it was not), the FCC would likely have been entangled in complex adjudications for several years as to what constitutes reasonable network management.

Second, we note that the order takes a significantly milder approach toward the mobile network, arguing that the mobile broadband environment is at an earlier stage of its development than fixed, and is also more competitive than fixed (in the US).[138] The European reader should bear three things in mind: (1) there is no over-arching principle of technological neutrality in US telecommunications law; (2) market power implicitly plays a role in US telecommunications law, but means of tailoring remedies in response to presence or absence of market power are largely lacking;[139] and (3) the US fixed broadband market is basically a series of geographically non-overlapping duopolies, while the mobile market has four nationwide players for the moment. Joint dominance of the cable network (the majority provider of broadband in the US) and the telecommunications network is arguably a nearly universal issue for the fixed network, but not for the mobile network.[140]

Third, the FCC signals a negative view toward Internet access arrangements that include tiered pricing for different services – they say that they are unlikely to satisfy restrictions on unreasonable discrimination in the fixed network. In nearly the same breath, they then speak about 'specialised services' that might include facilities-based IP voice or video services, presumably at a different price. As noted in Sections 2 and 3, there are sound technical and economic reasons for offering different levels of QoS at different price points; these could, however, be problematic in the presence of sufficient market power. The tacit implication once again is that joint market power is a general problem for the fixed network, but not necessarily for the mobile.

---

[138] One could also argue that mobile networks face significantly different capacity constraints than fixed networks.

[139] See J. Scott Marcus, Federal Communications Commission (FCC) Office of Strategic Planning and Policy Analysis (OSP) Working Paper 36, 'The Potential Relevance to the United States of the European Union's Newly Adopted Regulatory Framework for Telecommunications,' July 2002, available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-224213A2.pdf. The article and derivative works also appear in: *Rethinking Rights and Regulations: Institutional Responses to New Communications Technologies*, Ed. Lorrie Faith Cranor and Steven S. Wildman, MIT Press, 2003; in the *Journal on Telecommunications and High Technology Law* 111 (2003); and in the 2004 *Annual Review* of the European Competitive Telecommunications Association (ECTA).

[140] In the FCC's 2014 Open Internet NPRM, as we shortly explain, the FCC said much the same: '[T]he Commission found that most residential customers have only one or two options for wireline broadband Internet access service, increasing the risk of market power, and found the future of mobile Internet access service as a competing substitute remained unclear.'

Verizon challenged the 2010 Open Internet order in court. The complaint alleged that the order (1) exceeded the FCC's authority; (2) was 'arbitrary and capricious' (the standard phrasing that would be used in seeking to overturn a regulatory decision); and (3) that it violated the US constitution and other laws.[141] Some experts were surprised that Verizon chose to oppose the order, given that they had previously made a joint proposal with Google that seemed in most respects similar to the order that the FCC ultimately adopted.[142] The apparent explanation is that Verizon was less concerned with the substance of the order than with the breadth of authority that the FCC was asserting.[143]

In January 2014, the United States Court of Appeals for the District of Columbia Circuit sided for the most part with Verizon, thus overturning large parts of the FCC's 2010 Open Internet Report & Order.[144] The court acknowledged Section 706 of the Telecommunications Act of 1996 as a legitimate grant of authority to the FCC (some would argue incorrectly), but claimed that the common carrier obligations to which telecommunications services are subject cannot be imposed on information services providers.[145]

The FCC fastened on the court's acknowledgment of Section 706 as a grant of authority, and used it as the legal basis for a new Notice of Proposed Rulemaking (NPRM) in which it seeks to reinstate the 2010 rules on a firmer footing.[146] Since the FCC chose not to challenge the court's ruling, it would appear to effectively be *res judicata*, i.e. a settled matter.

The NPRM has gone through an extensive process of public consultation. Key elements of the proposed approach embodied by the new NPRM, and their interactions with the three rules from the Open Internet Order from 2010, are:

- Retaining the definitions and scope of the 2010 rules.
- **Rule 1: Transparency:** Retaining and enhancing the Transparency Rule (which was upheld by the D.C. Circuit).
- **Rule 2: No Blocking:** Retaining the No Blocking Rule from the 2010 Open Internet Order with a revised rationale.
- **Rule 3: No Unreasonable Discrimination:** In lieu of the No Unreasonable Discrimination Rule, requiring network operators to adhere to an enforceable legal standard of commercially reasonable practices.

[141] See Verizon's Notice of Appeal in the case, page 4.

[142] Verizon and Google had jointly called for creation of a regime based on (1) support for the principles of the FCC's *Internet Policy Statement*; (2) addition of a new principle prohibiting discrimination or prioritisation impacting lawful Internet content, applications or services in a way that causes harm to users or competition; (3) transparent disclosure of capabilities and network management practices to consumers; (4) case by case ex post enforcement; (5) enabling network operators to offer new, prioritised services; and (6) applying only the transparency obligations to mobile data.

[143] See the statement of Tom Taukey, 'Verizon Files Appeal in Federal Court Regarding FCC Net Neutrality Order', 20 January 2011. 'We are deeply concerned by the FCC's assertion of broad authority for sweeping new regulation of broadband networks and the Internet itself. We believe this assertion of authority goes well beyond any authority provided by Congress, and creates uncertainty for the communications industry, innovators, investors and consumers.'

[144] United States Court of Appeals for the District of Columbia Circuit (2014), Verizon v. FCC, 740 F.3d 623 (D.C. Cir. 2014).

[145] That the FCC cannot impose an equivalent obligation using a different legal basis seems perverse, but knowledgeable experts claim that it is correct under US law.

[146] FCC (2014), In the Matter of Protecting and Promoting the Open Internet, GN Docket No. 14-28, 15 May 2014.

- Asking how harm resulting from differentiated treatment can best be identified and prohibited, and whether certain practices (such as paid prioritisation) should be barred altogether.
- Creating a multi-faceted dispute resolution process.
- Asking on what legal basis the FCC might best ensure that the Internet remains open.

Of possible interest to European policymakers is the FCC's statement on the linkage between market power and network neutrality. In the 2014 Open Internet NPRM, the FCC notes that the 2010 Open Internet Order '… concluded that the threat of broadband provider interference with Internet openness would be exacerbated by — but did not depend on — such providers possessing market power over potential subscribers in their choice of broadband provider. However, the Commission found that most residential customers have only one or two options for wireline broadband Internet access service, increasing the risk of market power, and found the future of mobile Internet access service as a competing substitute remained unclear. Moreover, the Commission emphasized that customers may incur significant costs in switching from one provider to another, thus creating "terminating monopolies" for content providers needing high-speed broadband service to reach end users.'

The FCC, in other words, acknowledges the *de facto* duopoly nature of US broadband markets, and also a linkage between market power and 'interference with Internet openness', but claim that that interference does not depend on market power. That last claim should be read with caution – it is entirely possible that the FCC's statement is merely expedient. The FCC obviously believes that market power is important in regard to network neutrality deviations, otherwise they would not have treated fixed services differently from mobile in the 2010 Open Internet Order. It is likely that the FCC does not wish to have the burden of demonstrating the presence of market power (and the D.C. Circuit did not require them to). Under US law and regulatory practice for telecommunications, there is no standard mechanism for demonstrating what we in Europe would refer to as Significant Market Power in telecommunications – instead, obligations are imposed on entities that were subject to the historic break-up of the Bell System (even for markets where cable is now larger in market share). If the FCC had to demonstrate market power before being able to take action on network neutrality, they would face a high barrier indeed.

Many stakeholders have expressed concerns that the FCC is not dealing with interconnection aspects of network neutrality, but their decision is not surprising. The FCC's 2010 Order did not apply beyond 'the limits of a broadband provider's control over the transmission of data to or from its broadband customers.' In other words, the Order applied to a broadband provider's use of its own network but did not apply the no-blocking or unreasonable discrimination rules to the exchange of traffic between networks, whether peering, paid peering, content delivery network (CDN) connection, or any other form of inter-network transmission of data, as well as provider-owned facilities that are dedicated solely to such interconnection. The new NPRM maintains the 2010 approach, which seems prudent.

Meanwhile, the comment and response periods for the NPRM are formally closed, but key aspects continue to be debated vigorously in public. Assuming that a final Report and Order is eventually enacted, it remains unclear whether mobile services will be subject to non-discrimination obligations. It is also unclear whether the FCC will use the somewhat limited authority that the courts have now recognised under Section 706 of the Telecommunications Act of 1996, or will instead take the broader but politically and

judicially more sensitive approach of reclassifying broadband Internet access in order to reinstate its authority under Title II of the Communications Act of 1934 as amended.

The situation in the United States has been evolving day by day. Early in November of 2014, President Obama made a public statement urging the FCC to adopt strong network neutrality rules under Title II.[147] The FCC is formally an independent agency, but the President's request is surely important both in terms of guidance and in terms of political backing.[148]

6.1.2. Relevant regulation and legislation in the European Union

The response in Europe has reflected the introduction in 2003 of obligations imposed on network operators who have Significant Market Power (SMP) to make access to their networks available to competitors at regulated prices, terms and conditions.

The regulatory framework for electronic communications entails a carefully crafted division of responsibilities between the European Commission, the Member State National Regulatory Authorities (NRAs), and (since 2009) BEREC. The European Commission has delineated seven communications markets that are 'susceptible to ex ante regulation'. (Two of these are directly relevant to broadband.) Each NRA must evaluate these market definitions relative to its national circumstances, determine whether any undertakings possess significant market power on one of the markets, and (if SMP has been found) impose proportionate remedies. These NRA findings are subject to review by the Commission under a well-defined process.

The three most relevant remedies, all of which have been widely used in Europe, are:[149]

- **Local Loop Unbundling (LLU):** a copper pair (or equivalent) is rented to a third party for its exclusive use.
- **Shared access:** enables the incumbent to continue to provide telephony service while the new entrant delivers high-speed data services over that same local loop.
- **Bistream access:** the incumbent installs a high-speed access link to the customer premises, and makes this access link available to third parties (new entrants) over a shared access facility to enable them to provide high-speed services to customers.

These provisions are important to an understanding of the European response to network neutrality to the extent that they help to ensure retail competition for broadband services (see Section 6.2.2). As noted previously, effective retail competition for broadband makes harmful network neutrality problems less likely.

The non-discrimination obligation could also be relevant, but it is primarily conceptualised in terms of ensuring that a network operator that possesses SMP offers the same wholesale service to competitors that it supplies to itself; thus, it deals with a somewhat different issue than network neutrality.

Many other aspects of European regulation as enacted in 2002 touch on the network neutrality issue, but these (together with the changes implemented in 2009 that are discussed in the next section) would appear to be the most relevant.

---

[147] Barack Obama (2014), at http://www.whitehouse.gov/net-neutrality, viewed 23 November 2014.

[148] The political backing is likely to be important. It is likely that the Republican majority in both houses of the US Congress will attempt to hamper the effectiveness of any network neutrality rules that might be passed by withholding funding for the enforcement of the rules.

[149] There are many different formulations of these services. This form is based on the Commission's 15th Implementation Report, Annex 2.

Revisions to the regulatory framework in 2009

The European framework as adopted in 2002-2003[150] did not specifically address network neutrality, but network neutrality became a significant issue in the '2006' revisions to the regulatory framework, which were enacted late in 2009, and a number of changes to the regulatory framework were introduced as a result:

- Amendment of Article 8 of the Framework Directive to establish the ability of end users to access content, applications or services of their choice as an explicit goal of European policy.[151]
- Amendment of Article 20 of the Universal Service Directive to oblige providers of electronic communication services to inform their end users of their practices in regard to traffic management, and providing end users with the right to change providers without penalty if they are dissatisfied with a change in these practices.
- Empowerment of NRAs through Article 22(3) of the Universal Service Directive[152] to impose, if necessary, minimum QoS obligations on network operators.

The minimum QoS obligations have not been imposed, and are not very likely to be imposed any time soon. Thus, it is the transparency obligations that constitute the real, substantive change, but it is too soon to say how well they are working in practice.

Given that Europe has for the most part not experienced major problems with network neutrality, these relatively soft obligations may prove adequate. Europeans have a meaningful choice among network operators. The transparency obligations enacted in 2009, coupled with lower switching costs, may be sufficient to deter network operators from anticompetitive deviations from network neutrality.

Network neutrality laws in the Netherlands and in Slovenia

Network neutrality legislation at Member State level was enacted in the Netherlands in 2011, and in Slovenia in 2013.

The Dutch law was a direct result of public outrage over announcements by the Dutch network operator KPN of its intention to introduce a 'chat charge' for users of IP messaging applications such as WhatsApp in order to mitigate the negative impact that these applications were having on KPN's revenues from traditional SMS services. KPN also

---

[150] The regulatory framework for electronic communications, as revised in 2009, consists of one general and four specific directives, namely:

— Directive 2002/21/EC on a common regulatory framework for electronic communications networks and services (Framework Directive) as amended by Directive 2009/140/EC (Better Regulation Directive);

— Directive 2002/20/EC on the authorisation of electronic communications networks and services (Authorisation Directive) as amended by Directive 2009/140/EC;

— Directive 2002/19/EC on access to, and interconnection of, electronic communications networks and associated facilities (Access Directive) as amended by Directive 2009/140/EC;

— Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services (Universal Service Directive) as amended by Directive 2009/136/EC (Citizens' Rights Directive);

— Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector (e-Privacy Directive) as amended by Directive 2009/136/EC.

[151] 'The national regulatory authorities shall promote the interests of the citizens of the European Union by inter alia: … promoting the ability of end-users to access and distribute information or run applications and services of their choice; …"

[152] 'In order to prevent the degradation of service and the hindering or slowing down of traffic over networks, Member States shall ensure that national regulatory authorities are able to set minimum quality of service requirements on an undertaking or undertakings providing public communications networks.' The text goes on to establish coordination mechanisms between the Member States and the Commission.

revealed that it had used Deep Packet Inspection (DPI) in order to monitor the usage of certain applications on its mobile network, which raised privacy concerns.[153]

The key elements of the Dutch law are:[154]

- Providers of internet access services shall not block or delay applications on the internet, unless the measures by which applications are blocked or delayed are necessary:
    - to reduce the effects of congestion, where equal forms of traffic are treated equally,
    - for the integrity and safety of the network
    - to reduce the transmission of unsolicited communications (such as Spam), and
    - to execute a legal requirement or a court order.
- Providers of internet access services shall not make the price of the rates for internet access services dependent on the services and applications which are offered or used via these services.

The rules were intended to apply only to Internet access, not to other services delivered over the Internet. They are not intended to prevent offers of separate services (such as subscriptions only for Voice over IP (VoIP) services) over the Internet.[155]

The Slovenian network neutrality was passed at the end of 2012.[156] A partial, unofficial translation into English appears in Belli (2013).[157] Key elements include:

- The Agency encourages the preservation of the open and neutral character of the internet and the access to and dissemination of information or the use of applications and services of their choice of end users.
- Network operators and Internet access providers shall make every effort to preserve the open and neutral character of the internet, thus it may not restrict, delay or slowing Internet traffic at the level of individual services or applications, or implement measures for their evaluation, except in case:
    - necessary technical measures to ensure the smooth operation of networks and services (e.g., to avoid traffic congestion);
    - necessary steps to preserve the integrity and security of networks and services (e.g., elimination of unfair seizure of over a transmission medium - channel);
    - emergency measures for limiting unsolicited communications in accordance with … this Act;
    - decision of the court.

[153] The discussion of the Dutch law is based on Robert Stil (2012), 'Net neutrality in the Netherlands', a presentation to the Muenchner Kreis, 23 January 2012.

[154] Ibid.

[155] Ibid.

[156] See the Official Gazette of the Slovenian Republic, 31 December 2012, at http://www.uradni-list.si/_pdf/2012/Ur/u2012109.pdf#!/u2012109-pdf. See also Innocenzo Genna, 'Slovenian reinforces net neutrality principles', radiobruxellaslibera, 30 January 2013: http://radiobruxelleslibera.wordpress.com/2013/01/03/slovenia-reinforces-net-neutrality-principles/.

[157] Luca Belli (2013), 'Network Neutrality and Human Rights: An Input Paper', in *The Value of Network Neutrality for the Internet of Tomorrow*, Dynamic Coalition for Network Neutrality.

- The measures provided for in [relevant articles] of the preceding paragraph shall be proportionate, non-discriminatory, limited in time and to the extent that this is necessary.

Neither law has proven to be particularly problematic *per se*, in the opinion of this author; however, the long term effects and effectiveness continue to be uncertain at this time.[158] The network neutrality portions of the European Commission's 'Telecoms Single Market' proposals of 11 September 2013 were motivated in large part, in our judgment, by valid concerns that enactment of different network neutrality laws in multiple Member States might lead to inconsistencies and incompatibilities that would impede the Single Market (see below).

The Telecoms Single Market (TSM) Regulation

Efforts by the European Commission and the European Parliament in 2013 and 2014 to strengthen the Digital Single Market for electronic communications potentially have great relevance for network neutrality in the EU.

On 11 September 2013, the European Commission put forward its Telecoms Single Market proposals to the Parliament.[159] These proposals covered a wide range of issues covering authorisation, spectrum management, international mobile roaming, and more; however, only the network neutrality and related consumer protection aspects are relevant to the current study.[160] The Commission's text sought to codify the rights of consumers 'to access and distribute information and content, run applications and use services of their choice via their internet access service', thus giving consumers for the first time enforceable rights in regard to goals that already appear in Article 8 of the Framework Directive.[161] Article 23 of The Telecoms Single Market Regulation stipulates, with minor exceptions, that 'providers of internet access services shall not restrict the freedoms […] by blocking, slowing down, degrading or discriminating against specific content, applications or services, or specific classes thereof'.

It is noteworthy that the language of Article 23 of the Telecoms Single Market Regulation assures network operators of the ability to provide 'specialised services with an enhanced quality of service'. We consider this to be entirely appropriate, for reasons discussed at length in Chapters 2, 3, and 4.

As noted above, we believe that this part of Telecoms Single Market was inspired by valid concerns that unwise acts at Member State level might interfere with the provision of services with an enhanced quality of service. Were that to happen, it could potentially lead

---

[158] Cf. Chris Marsden (2013), 'Net Neutrality: Past Policy, Present Proposals, Future Regulation?', *The Value of Network Neutrality for the Internet of Tomorrow*, Dynamic Coalition for Network Neutrality. 'Field research is needed to examine the effectiveness of such laws and their operator and consumer effects.'

[159] European Commission, Proposal for a regulation of the European Parliament and the Council laying down measures concerning the European single market for electronic communications and to achieve a Connected Continent, and amending Directives 2002/20/EC, 2002/21/EC and 2002/22/EC and Regulations (EC) No 1211/2009 and (EU) No 531/2012, 11 September 2013, COM(2013) 627 final.

[160] In previous work for the European Parliament, this author expressed concerns about many aspects of the Telecoms Single Market Regulation; however, the network neutrality portion was viewed as an area of relative strength. See J. Scott Marcus, Ilsa Godlovitch, Pieter Nooren, Bram van den Ende, Jonathan Cave and Werner Neu: 'How to Build a Ubiquitous EU Digital Society', November 2013, available at: http://www.europarl.europa.eu/RegData/etudes/etudes/join/2013/518736/IPOL-ITRE_ET(2013)518736_EN.pdf.

[161] Directive 2002/21/EC of the European Parliament and of the Council of 7 March 2002 on a common regulatory framework for electronic communications networks and services ("Framework Directive"); available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002L0021:EN:NOT.

to a patchwork quilt of legal and regulatory impediments that could impede quality-of-service-aware offers, thus negatively impacting the Single Market and the broader economy. (As we noted in Section 5.8, many stakeholders appear to share this view.) This intent on the part of the Commission is especially visible in the language that effectively protects network operators and service providers from interference in offering specialised services. 'In order to enable the provision of specialised services to end-users, providers of content, applications and services and providers of electronic communications to the public shall be free to enter into agreements with each other to transmit the related data volumes or traffic as specialised services with a defined quality of service or dedicated capacity.' These provisions would have facilitated the creation of QoS-aware services between network operators, thus possibly enabling QoS-aware cross-border services that could contribute to the Single Market.[162]

If the goal is to inhibit a proliferation of potentially incompatible network neutrality laws at Member State level, the use of a Regulation rather than some 'softer' instrument might indeed be necessary.[163]

On 3 April 2014, the European Parliament passed on First Reading a Telecoms Single Market Regulation (TSM) based on the Commission's proposed text, but greatly simplified and reduced in scope. The network neutrality provisions were retained, in general, but altered and strengthened. The TSM Regulation is currently being reviewed by the Council.[164] Negotiations between Council and Parliament can be expected in the coming months.

BEREC has expressed concerns in regard to the network neutrality aspects of the TSM Regulation.[165] They caution that both the Commission's original proposal and the TSM Regulation as passed on First Reading would turn 'a flexible and progressive regulatory regime (under the 2009 Framework) into a rigid regulatory system'. They go on to say that '… BEREC would instead prefer an approach based on principles rather than detailed rules … If a rules-based approach is nonetheless to be pursued, then further work would be required to ensure that the definitions and rules were legally precise, future-proof and enforceable in practice. While some of the language in the text adopted by European Parliament draws upon BEREC previous publications on the subject, improving the original Commission's proposals, it does not yet meet these standards.'

[162] We noted the potential benefits in European Parliament (2011a), Network Neutrality: Challenges and responses in the EU and in the US

[163] Consider, however, the statement of the Hellenic Presidency of the Council: 'While all delegations supported the principle of open internet (art. 23), views differed as to whether it is the right moment in time to regulate this issue now and whether to address it in this Regulation or in the Universal Directive or to even introduce in a 'soft' instrument, such as Recommendation or BEREC guidelines.' Hellenic Presidency (2014), 'Progress Report: Proposal for a Regulation of the European Parliament and of the Council laying down measures concerning the European single market for electronic communications and to achieve a Connected Continent, and amending Directives 2002/20/EC, 2002/21/EC and 2002/22/EC and Regulations (EC) No 1211/2009 and (EU) No 531/2012', 10109/14, 26 May 2014.

[164] Work began during the Greek Presidency, and will presumably be brought to a conclusion during the Italian Presidency.

[165] BEREC (2014), 'BEREC publishes its views on the European Parliament first reading legislative resolution on the European Commission's proposal for a Connected Continent Regulation', 17 May 2014, available at: http://berec.europa.eu/eng/news_consultations/whats_new/2203-berec-publishes-its-views-on-the-european-parliament-first-reading-legislative-resolution-on-the-european-commissions-proposal-for-a-connected-continent-regulation.

6.2. Broadband markets

Unlike Europe, cable is the majority fixed broadband medium in the United States. Fixed network competition is primarily between cable and telecommunications. Competitive access to telecommunications has negligible. Broadband markets differ in these respects and in many others.

6.2.1. Broadband markets in the United States

Broadband markets in the US are dramatically different from those in the EU. In the US, broadband access is potentially available to most households by means of *both* cable television and telecommunications; however, wholesale remedies were effectively eliminated a few years ago (see Section 6.1), so most Americans in practice confront a duopoly.[166] They can choose between one cable-based broadband provider and one telecommunications-based broadband provider. Other forms of broadband may be physically available, but they do not serve as meaningful economic substitutes for these two forms of fixed broadband access.

Procompetitive remedies such as local loop unbundling (LLU), shared access and bitstream access were largely phased out during the George W. Bush years. Their use peaked in 2002 at a bit more than 5% of all DSL access lines. Today, they are an insignificant factor in the marketplace.[167] Nearly all DSL lines today are provided by the local incumbent.

In its 2010 National Broadband Plan, the FCC itself provided a clear summary.[168]

> *Unlike many countries, the majority of U.S. broadband subscribers do not connect to the Internet via local-access infrastructure owned by an incumbent telephone company.*
>
> *The U.S. cable infrastructure was advanced and ubiquitous enough to allow cable companies to offer broadband access services to large portions of the country, in many cases before the telephone companies. As a result, the U.S. market structure is relatively unique in that people in most parts of the country have been able to choose from two wireline, facilities-based broadband platforms for many years. Approximately 4% of housing units are in areas with three wireline providers (either DSL or fiber, the cable incumbent and a cable over-builder), 78% are in areas with two wireline providers, about 13% are in areas with a single wireline provider and 5% have no wireline provider (see [Figure 14]).*
>
> *These data do not necessarily mean that 82% (78% + 4%) of housing units have two or three competitive options for wireline broadband service—the data used here do not provide adequate information on price and performance to determine if multiple providers present in a given area compete head-to-head. …*

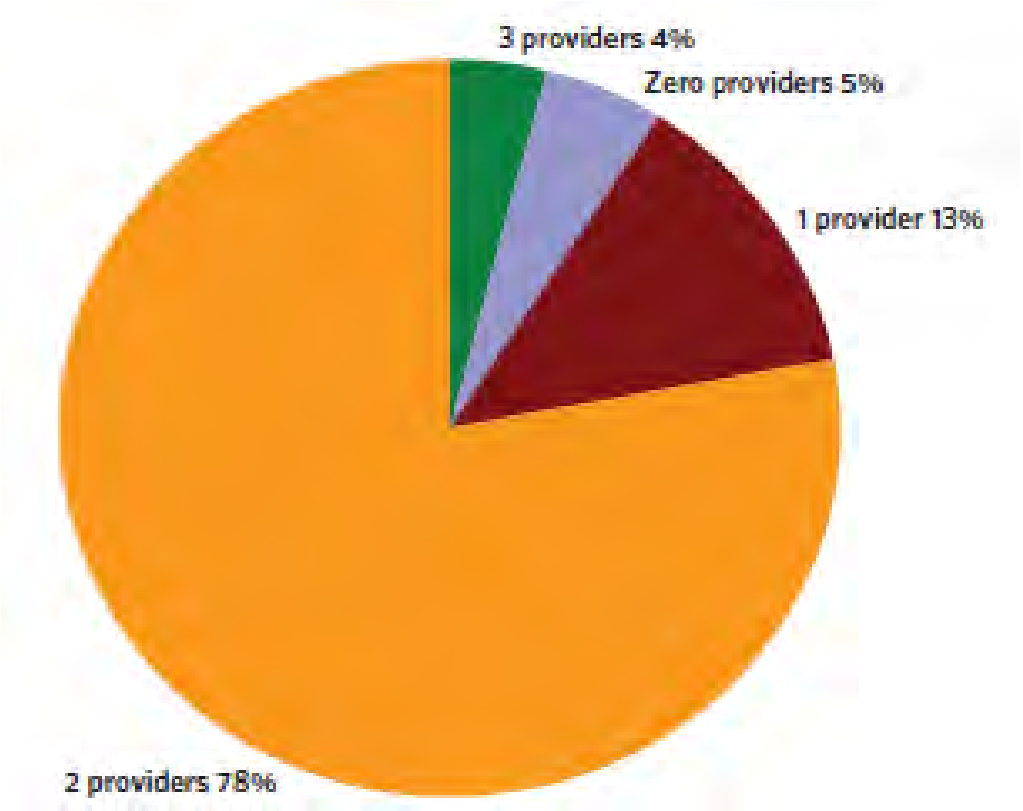
[166] Unlike most of Europe, the US is characterized by multiple incumbents. The territorial division of the fixed telephone network continues to largely follow the lines established with the breakup of the former Bell System in 1982. AT&T, Verizon and US West cover the majority of the US population with non-overlapping territories, while rural areas are served by a large number of tiny incumbent operators. Broadband competition among these network operators is negligible (see Section 6.1.1), largely due to gaps in the regulatory system. Cable operators also choose non-overlapping territories in almost all cases.

[167] J. Scott Marcus (2005), 'Is the U.S. Dancing to a Different Drummer?', in *Communications & Strategies*, no. 60, 4th quarter 2005.

[168] FCC (2010), National Broadband Plan, March 2010.

There are other types of fixed broadband providers. For instance, satellite-based broadband service is available in most areas of the country from two providers, while hundreds of small fixed wireless Internet service providers (WISPs) offer service to more than 2 million people and Clearwire offers WiMAX service in a number of cities. These providers compete for customers as well, although their services tend to be either more expensive or offer a lower range of speeds than today's wireline offerings.

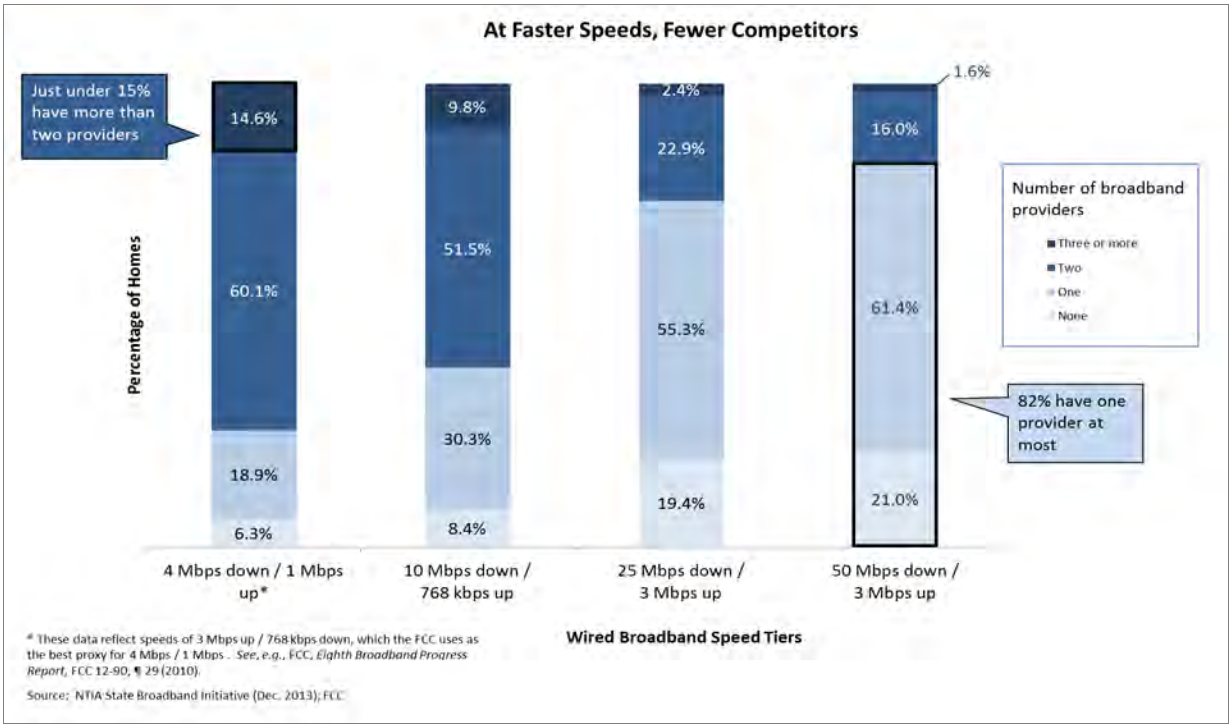
Figure 14: Share of housing units in US census tracts with 0, 1, 2, or more fixed network operators



Source: FCC, National Broadband Plan, March 2010.

In a recent speech, FCC Chairman Wheeler provided updated data. The degree of consumer choice is substantially less for fast broadband than for basic broadband. For basic broadband (with at least 4 Mbps downstream capacity and 1 Mbps upstream capacity), three quarters of Americans have at least two choices of broadband provider, and 15% have a choice of three or more); however, for moderately fast broadband (with at least 25 Mbps downstream capacity and 3 Mbps upstream capacity), only one quarter of Americans have at least two choices of broadband provider, and only 2% have a choice of three or more.

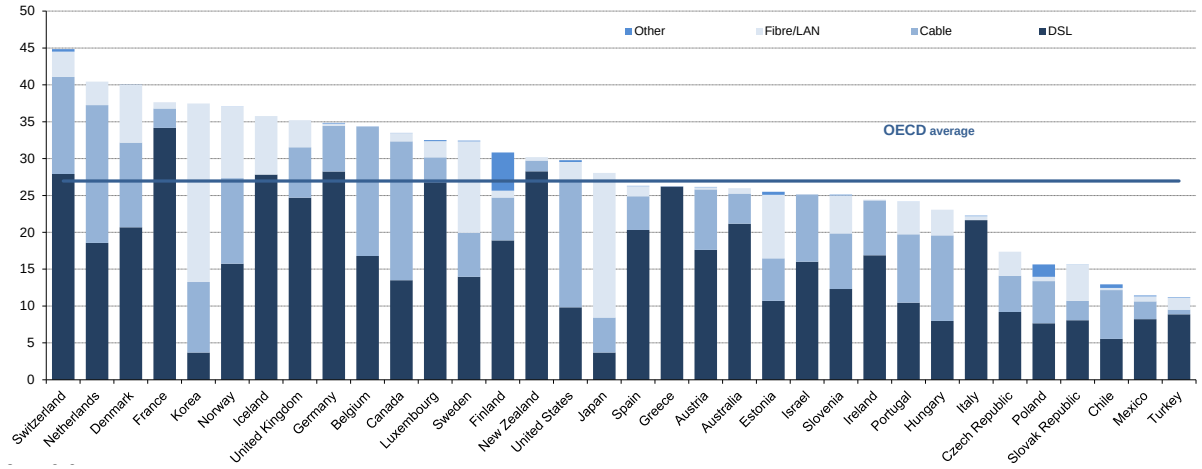
Figure 15: Number of broadband providers available to US consumers at various speeds (2013)



Source: Speech by FCC Chairman Wheeler, data based on NTIA State Broadband Initiative[169]

The high adoption of cable broadband services is visible in OECD fixed broadband statistics. At 17.3 cable broadband subscriptions per 100 inhabitants, the United States is in a similar range to that of the Netherlands, Canada, and Belgium.[170] The OECD's assessment of broadband subscriptions per 100 inhabitants provides the best cross-comparable international data for international comparisons; however, one should take care with EU-US comparisons, because the average number of individuals per household is higher in the US than in the EU.

Figure 16: OECD fixed (wired) broadband subscriptions per 100 inhabitants, by technology (December 2013)



Source: OECD broadband portal.

[169] US NTIA (2014), Broadband Statistics Report, available at: http://www.broadbandmap.gov/download/TechnologyBySpeedDec2013_updated.pdf.

[170] OECD (2014), table 1d, at http://www.oecd.org/sti/broadband/oecdbroadbandportal.htm.

OECD statistics make clear that there are roughly as many mobile broadband subscriptions in the United States as inhabitants;[171] however, the degree to which the service should be primarily viewed as an *economic complement* to fixed access rather than a *substitute* is unclear.

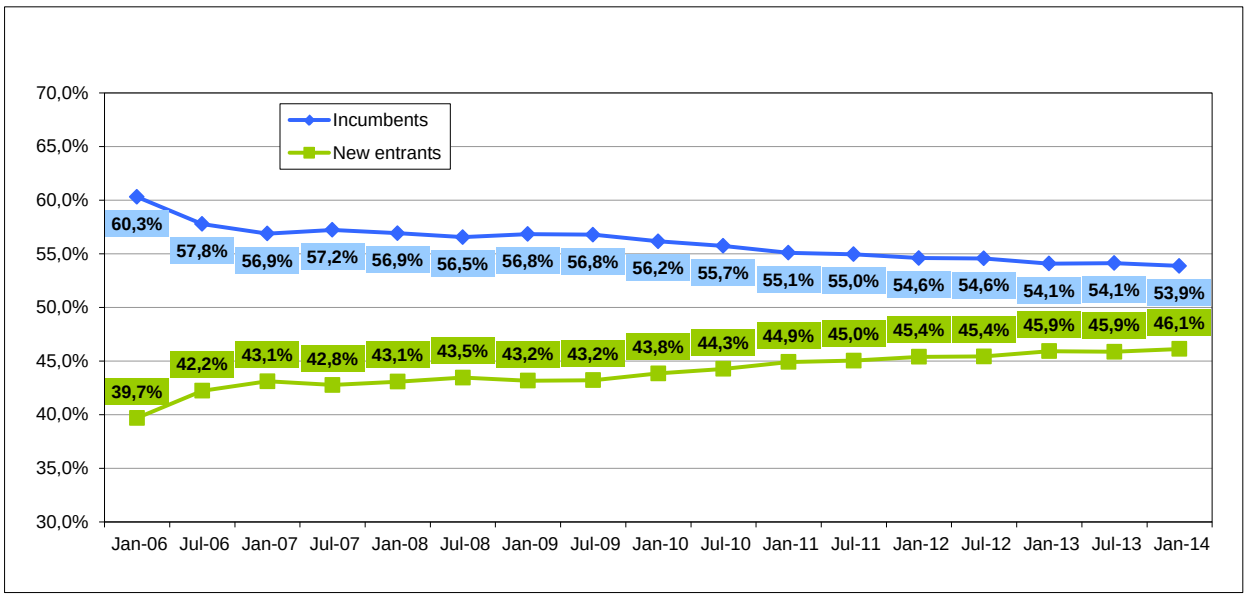
6.2.2. Broadband markets in Europe

These figures stand in stark contrast to equivalent European values. Overall, there is a richer and more complex competitive environment in Europe; however, the availability of cable television in Europe is uneven, meaning that there is typically only one fixed network connection to each home.

Procompetitive remedies (LLU, shared access and bitstream) are effective in many European countries. 46% of DSL lines in the EU-27 are provided by new entrants rather than by the incumbent (see Figure 17).[172] For most of the EU, this high percentage of a key form of broadband provided by competitors means that large numbers of Europeans can choose among multiple broadband network services, not just one or two.[173]

At the same time, it is clear a few of the Member States do not (yet) enjoy significant take-up of competitive DSL services (see Figure 18).[174] In some of these Member States, choice may be more limited.

Figure 17: Incumbent versus new entrant DSL access lines in the EU (2006 to 2014)



Source: European Commission[175].

[171] Ibid.

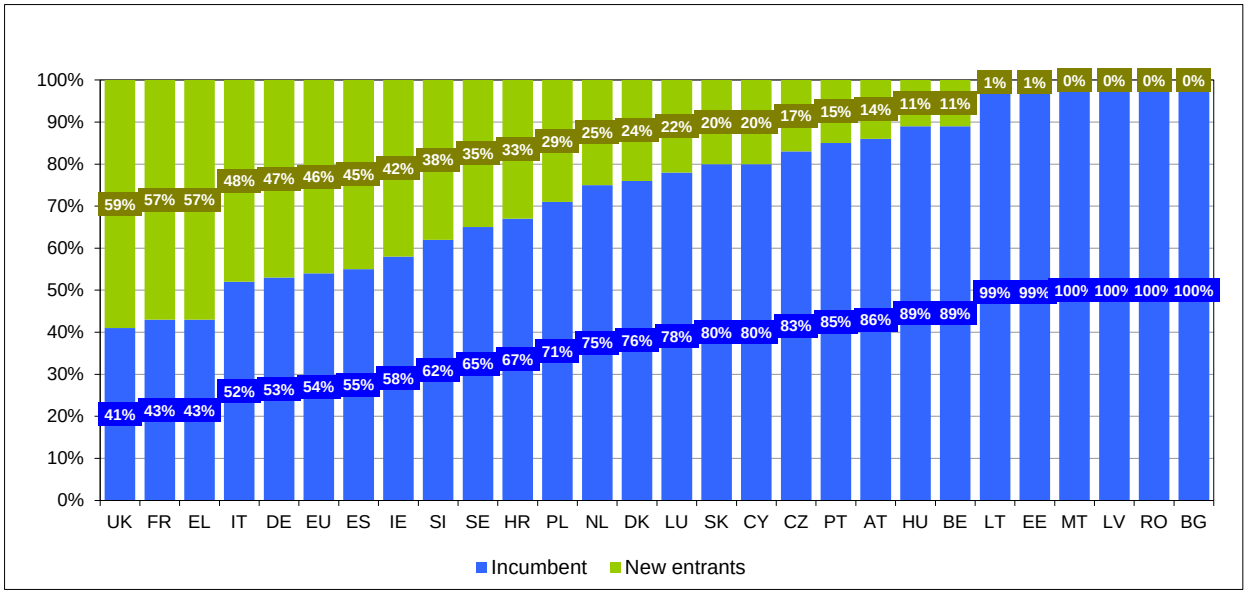
[172] European Commission (2014), Digital Agenda Scorebaord, Broadband Indicators, available at: http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?action=display&doc_id=5935.

[173] Many of these services are, to be sure, delivered over the incumbent's lines; nonetheless, they are independently managed, and therefore provide a distinct choice that is relevant in terms of network neutrality.

[174] Ibid. Reasons for this vary from one Member State to the next. In some of the newer Member States, the fixed network is still not fully built out, but cable plays a relatively large role.

[175] European Commission (2014), Digital Agenda Scorebaord, Broadband Indicators, available at: http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?action=display&doc_id=5935.

Figure 18: Incumbent versus new entrant DSL market share by Member State (January 2014)



Source: European Commission[176]

Survey data can serve as a useful cross check on European Commission and OECD data, because (1) they can capture per-household characteristics rather than being limited to per-individual, and (2) they can correct for the case where a household has more than one subscription. Eurobarometer survey data show that 59% of those EU-27 households that have Internet at home get their broadband by ADSL or similar, only 19% by cable, 10% by mobile broadband, 6% by fibre optic, 3% by satellite, and 1% via power lines.[177] The role of cable broadband is, however, extremely uneven among the Member States – it is the most common connection type in 14 countries, and is most widespread in households in Hungary (66%), Portugal (52%), Bulgaria (49%) and Romania (48%); however, cable is not used at all in Italy or Greece.[178]

6.3. Competition law

In Europe, competition law is largely seen as an *ex post* complement to *ex ante* sector-specific regulation. Competition law might potentially deal with some network neutrality violations; however, it might be too slow and ponderous to provide the relief needed. Whether competition law would represent an effective remedy for network neutrality in practice is unproven and untested.

Competition law (antitrust) cannot possibly play the same role in the United States. Pursuant to a number of court cases,[179] competition law is largely pre-empted by sector-specific regulation. More specifically, the provisions of the Communications Act of 1934 as amended cannot constitute a separate cause of action under competition law.

[176] Ibid.

[177] European Commission, E-Communications Household Survey, Fieldwork: January 2014; Publication: March 2014; Eurobarometer 414, page 49.

[178] Note that Eurobarometer per-household figures are not directly comparable to the US figures because each Member State has a different number of households with access to the Internet at home, i.e. a different denominator for the percentages. The average number of individuals per household is much higher in the US than in the EU.

[179] Notably *Goldwasser v. Ameritech Corp*. 222 F.3d 390 (7th Cir. 2000) and Law Offices of *Curtis V. Trinko*, *L.L.P. v. Bell Atlantic Corp*., 294 F.3d 307 (2nd Cir. 2002).

It is also worth noting that competition law in the United States differs in many ways from that of Europe – for example, if a firm has achieved market power through legal means, the firm is not prohibited from charging a monopoly price.

6.4. Comparison

Differences between the EU and the US in terms of markets, regulation, and competition law are substantial.

The US is blessed with two independent wires to nearly all homes – both telecommunications and cable television. Cable television coverage in Europe is, by contrast, very uneven – a number of regions in Europe have substantial cable coverage, but few Member States have more-or-less universal cable availability across the entire national territory. At the same time, thanks to effective last mile regulation, a great many European consumers can choose from among several providers of broadband network access, which is from the perspective of network neutrality greatly preferable to the *de facto* duopolisation of the US broadband market. For both conventional telecommunications (e.g. via ADSL) and cable, however, the situation varies significantly from one European Member State to the next.

The US regulatory environment stands in sharp contrast to European practice. As previously noted, the European framework as adopted in 2002-2003 did not specifically address network neutrality, but network neutrality became a significant issue in the '2006' revisions to the regulatory framework, which were enacted late in 2009. The 2009 amendments include (1) transparency provisions, (2) a backup power for the NRA to impose a minimum level of QoS on an SMP network operator, and (3) new language in Article 8 that establishes the right of users to access content, services or applications of their choice as a basic goal of the regulatory framework.

The transparency provisions in the FCC's Open Internet ruling are similar to the enhancements to the Universal Service Directive that serve to ensure that consumers understand the traffic management practices of their network service providers, and that gives them a right to switch without contractual penalty if they are dissatisfied with a change in those policies. This, then, is a point of commonality; however, the effectiveness of transparency is likely to be greater in Europe than in the US, because most European consumers have more alternative providers to which they could potentially switch. That the FCC felt it necessary to add rules to explicitly prevent blocking and unreasonable discrimination suggests that there was no confidence that a transparency rule alone would suffice.

In Europe, there *is* an additional back-up power: The authority for the NRA to impose a minimum level of QoS on a network operator that has SMP. This power has not yet been invoked, and it is entirely possible that the transparency and switching measures alone will suffice for Europe.

It is also worth noting that many of the Internet Policy Statement principles – that consumers should have the right to access content and use applications or devices of their choice – are reflected in Article 8 of the Framework Directive as revised in 2009, even if these changes have not yet lead to explicit operative language.

The Telecoms Single Market Regulation that the Parliament approved at First Reading in April 2014 could change European network neutrality arrangements greatly provided that Parliament and Council reach agreement.

Competition law as a remedy to deviations from network neutrality might possibly be effective in the European Union; in the US, by contrast, competition law cannot be effective.

A comparison of the framing conditions in the EU and the US appears in Table 1. Network neutrality measures are not shown, since they are in flux on both sides of the Atlantic (with the exception of network neutrality transparency measures, which are in place and can be expected to remain in place).

Table 1: Comparison between the European Union and the United States

	European Union	United States
Number of fixed connections available to most homes	1 or 2	2
Majority of fixed broadband lines	DSL	Cable
Number of alternative operators available on most fixed telecommunication (not cable) lines	Many	None
LLU obligations on access network (SMP) operators	Yes	Copper only
Shared access obligations on access network (SMP) operators	Yes	No
Bitstream obligations on access network (SMP) operators	Yes	No
Nondiscrimination obligations on broadband network (SMP) operators	Yes	No
Transparency obligations for net neutrality	Yes	Yes
Competition law as a net neutrality remedy	Possibly effective	Ineffective

7. FINDINGS AND REFLECTIONS FOR CONSIDERATION

In this chapter, we present our findings, and provide our reflections for consideration by the Parliament going forward in light of those findings and in light of the topics that will likely need to be discussed with Council.

7.1. Key findings

Each chapter of this report begins with a summary of Findings. In this section, we bring these key findings together.

7.1.1. General observations

- There are many different definitions of network neutrality. The differences in these definitions, which are visible on both sides of the Atlantic, reflect (1) whether they express what users of the network must be enabled to do, versus what providers of the network are prohibited from doing; and (2) whether they seek to broadly limit differentiated treatment in general, versus imposing a more limited restriction on harmful or anticompetitive discrimination.
- This is a difficult and contentious topic. In this study, we strive to provide clear findings and conclusions, while recognising that it is impossible to please all stakeholders.
- Network neutrality addresses a wide range of potential threats to consumer welfare, not all of which have been seen in practice.

7.1.2. Technical aspects

- Quality discrimination was not a major issue for traditional fixed voice networks, but it is very much an issue for IP-based networks.
- Quality of Service (QoS) in an IP-based network reflects many variables, notably including the average and variance of queuing delay; propagation delay; and the probability of packet loss.
- The user's Quality of Experience (QoE) is largely a function of these same parameters, but is heavily dependent on the particular application that the user is making of the network. Some applications (especially Voice over IP (VoIP)) are much more sensitive to delay or loss than others.
- Much of the focus in the network neutrality debate has been on prioritisation within the network; however, nearly the same effect can be achieved by Content Delivery Networks (CDNs) and other forms of caching, and by cloud services and other forms of replication. These alternative mechanisms for achieving differentiated Quality of Service have not raised significant network neutrality concerns, perhaps because most of the firms that provide them are not perceived as having incentives to practice harmful discrimination.
- The Internet is a complex interconnected system of networks. Most of these interconnections take place by means of variants of peering and transit.
- QoS within ISP networks is commonplace, and has been for years, but QoS-aware peering continues to be extremely rare.

- The Internet has experienced peering disputes from time to time over the past fifteen or twenty years. Nearly all have been between a content-heavy ISP that sends a great deal of traffic, and an 'eyeball'-heavy ISP that receives a great deal of traffic.
- These disputes are a function of the default 'shortest exit' routing used in the Internet. The use of alternative routing schemes and/or caching and CDNs could potentially serve to ameliorate the tensions that cause these conflicts.
- It is sometimes claimed that the differentiated QoS somehow violates core principles of the Internet (such as the end to end principle). In fact, differentiated QoS was always a design consideration for the Internet (although not fully implemented). Its rich history goes back decades, to the earliest days of the Internet and its predecessor networks.

7.1.3. Economic aspects

- There are different economic views of network neutrality. Differences in quality and price in most circumstances are benign; however, some forms can be harmful.
- Quality differentiation is a well understood practice that, in the absence of anticompetitive discrimination, general benefits both producers and consumers.
- When a producer with market power in one market segment attempts to project that market power into upstream or downstream segments that would otherwise be competitive, that constitutes economic foreclosure. Foreclosure harms consumers, and imposes an overall socio-economic deadweight loss on society.
- The Internet can be thought of as a two-sided market, with network operators serving as a platform connecting providers of content (e.g. web sites) with consumers. Under this view, some disputes are simply about how costs and profits should be divided between the network operators and the two (or more) sides of the market. This is a relatively benign interpretation.
- The number of viewers/customers that one has can provide a special form of market power associated with network effects. Network effects interact with other economic aspects in complicated ways.
- Quite a bit of relevant work has been done by the economists over the past ten years. A number of apparently sound papers suggest that, for markets where competition is effective (presumably taking into account other regulation already in place), market based solutions are likely to be superior to imposed regulatory solutions (including an obligation not to charge for interconnection) because the regulatory solutions necessarily ignore market signals. Otherwise, the results are largely inconclusive – a great many factors influence whether network neutrality regulation is, on balance, positive or negative for societal welfare.

7.1.4. Public policy aspects

- To an economist, quality differentiation and quality discrimination are roughly synonymous; however, we have largely avoided the term discrimination in this report because the word carries negative connotations.
- Prioritisation is not per se deleterious. Under many circumstances, prioritisation benefits all concerned.

- We would argue that any specific measures related to network neutrality need to be carefully and narrowly targeted so as not to interfere with societally beneficial uses of the same instruments.
- Network neutrality could be viewed as generating three dimensions of conflicts: (1) vertical conflicts, (2) horizontal conflicts, and (3) diagonal conflicts.
- The recent Netflix Comcast dispute (and subsequent agreement) can be viewed as a diagonal conflict. It reflects a complicated mix of multiple elements already discussed, including (1) a classic peering dispute, (2) vertical foreclosure, and (3) a two-sided market accommodation.
- In Commission public consultations and BEREC Common Positions over the years, a consistent theme is that there have been very few instances of harmful discrimination. One possibly worrisome area that stands out as an exception relates to VoIP, especially in mobile devices; this, however, could perhaps be addressed with narrowly targeted remedies.
- Services including VoIP, videoconferencing, certain forms of gaming, and mission critical services such as Public Protection and Disaster Relief (PPDR) and transport could potentially benefit from traffic management.
- The NRAs have repeatedly stated through BEREC that they believe that they already have sufficient powers to address any network neutrality issues that might arise.
- One recent study raises possibly legitimate concerns about the effectiveness of existing European remedies. Given the scarcity of problematic incidents, this may or may not be a concern.
- Concerns that network operators would choose to offer prioritised and/or specialised services in such a way as to make non-prioritised services unattractive or unusable seem to us to be speculative or overblown. Similarly, concerns that the most successful content and application providers would use quality differentiation to crowd out smaller competitors seem to us to be speculative or overblown.
- Threats to freedom of expression are a serious concern worldwide, but do not seem to require special network neutrality measures within Europe.

7.1.5. Stakeholder views

- The Commission conducted a public consultation on network neutrality at the end of 2012, with an eye to a legislative initiative in 2013. For whatever reason, the Commission never published a comprehensive analysis of the results of that public consultation; nonetheless, the 131 non-confidential textual stakeholder responses are publicly available, and generally are thoughtful and of high quality. It is therefore possible to effectively complete the public consultation today, and thus to build this report on a firm foundation.
- The Commission's 2012 public consultation on network neutrality could perhaps be said to have reached a consensus to the effect that traffic management on the part of ISPs can be permissible in general under suitable conditions; however, traffic management is not permissible when it is used in anticompetitive or harmful ways, such as blocking legitimate content or applications, unreasonably degrading services, or impeding services competing with the ISP's own services.
- A mix of different traffic management tools is used in different ways in Europe today, and in many cases with different objectives.

- Stakeholder views on traffic management measures were diverse.
    - Citizens were troubled by most forms of traffic management, but troubled by some forms more than by others.
    - Different perspectives were visible among NRAs, ISPs, content providers, and consumer advocates. Most considered traffic management to be appropriate under suitable preconditions.
- For restrictions on specific applications (VoIP, P2P), network operators had (unsurprisingly) a dramatically different perspective from that of applications and content providers. Consumer advocates and other civil society organisations appear to be deeply troubled by limitations on Voice over IP (VoIP).
- Substantially all organisational respondents agreed that for a network operator to prioritise its own traffic ahead of traffic for applications that compete with its own services is problematic.
- A wide range of stakeholders felt that for the Member States to implement divergent approaches would carry substantial risk.
- Stakeholders expressed varied views on the need for new legislative and/or regulatory measures. Some saw an urgent need for legislative measures, others (including BEREC and most NRAs) felt that current instruments were sufficient.

7.1.6. Network neutrality regulation in the United States and the European Union

- The US regulatory approach to network neutrality that is likely to emerge shortly responds to different circumstances than those relevant to Europe. The overall US regulatory approach is partly a cause, and partly a response, to a very different marketplace.
- Most US homes are able to receive broadband from either a cable television provider or a telecommunications provider; however, deregulation has resulted in the disappearance of competitive providers (using LLU or shared access) in the US, resulting in a market environment that is essentially duopolistic.
- The same deregulation makes it difficult or impossible for the FCC to take action on network neutrality, which is perhaps more worrisome in the US than in Europe due to the duopoly nature of the market.
- The FCC's new 2014 Open Internet proceeding seeks to reinstate network neutrality protections that were put in place in 2010 but invalidated by the courts (see Section 6.1.1).
- Many European homes are served by only a single fixed telecommunications network operator; however, many Europeans nonetheless have the opportunity to be served by any of a number of broadband providers thanks to a regulatory framework for last mile fixed network access in Europe (based on LLU, shared access and bitstream) that is generally effective.
- The richer competitive market structure in Europe, together with a more robust regulatory and competition law environment, has likely contributed to the low level of network neutrality incidents that have been observed in Europe to date.
- Experience with network neutrality legislation outside of Europe and North America is inconclusive to date. In Chile, there have been claims that the legislation enacted

in 2010 has negatively impacted the use of mobile Internet services.[180] In Brazil, it is too soon to judge the effects of the legislation enacted in April, 2014.[181]

- The European Commission's decision to include network neutrality as part of a Regulation was inspired by concern over a possible proliferation of potentially inconsistent or incompatible legislation at Member State level (as enacted by the Netherlands in 2011, and by Slovenia in 2013), not by concerns that the NRAs lacked authority to deal with network neutrality issues.[182]

7.2. Reflections for the Parliament to consider going forward

In the recommendations in our 2011 study of network neutrality for the European Parliament,[183] we struck a cautious note toward the overall approach to be taken. We are still of the view '… that it is important to avoid inappropriate, disproportionate, or premature action. … It is conceivable that one or more of the problems that have been warned of, but not observed, might emerge in time; however, our view is that no public policy response should be undertaken until such a problem has been observed and understood. Preventative measures for threats that may or may not appear risk doing more harm than good.'

Actual network neutrality incidents still appear to be rare. As recently as June of 2014, BEREC noted that 'very few NRAs have reported specific relevant net neutrality incidents.'[184] Some, however, might disagree with that assessment (see Section 4.3.1 and Section 5.4).

Meanwhile, it is important to ensure that any approach that is taken is sufficiently *future proof*. There is considerable uncertainty as to the future evolution of the Internet value chain, as BEREC has observed in its most recent work plan. 'BEREC has taken note of a growing number of new products and services that make use of electronic communications infrastructure, and which may affect the ICT value chain. In light of these developments, BEREC will assess the potential changes in the ICT value chain and the possible evolution of digital markets in the internet ecosystem, including potential issues relevant to policy makers, and will consider whether and how to address them.'[185] In light of this uncertainty, an overly rigid regulatory response might easily guess wrong, thus locking Europe in prematurely.

The need for caution applies with equal or greater force to actions taken at Member State level, with the attendant danger of a proliferation of inconsistent and possibly incompatible approaches to network neutrality across Europe (see especially Sections 5.8 and 6.1.2).

---

[180] Lauren Walker (2014), 'How is Net Neutrality Working for the Countries That Have It?', *Newsweek*.

[181] Reuters (2014), 'Brazilian Congress Passes Internet Bill of Rights'.

[182] See, for instance, the European Commission's 2013 Impact Assessment for the Telecoms Single Market Regulation: 'Absent clear and predictable rules at EU level, some EU Member States have begun to adopt their own approaches regarding traffic management practices (often referred to as 'net neutrality'). Regulatory measures have been developed at national level ranging from nonbinding instruments (self-regulatory measures in the United Kingdom and Denmark) and more elaborated guidelines (NRA guidance in France) to the enactment of specific legislation on net neutrality (the Netherlands and Slovenia). Additionally, Germany is planning to adopt legislative proposals in the near future. Several initiatives have been announced or are under preparation in other Member States. This could result in further fragmentation of the Single Market that significantly complicates the integrated management of multi-territorial networks.'

[183] J. Scott Marcus, Pieter Nooren (TNO) and Jonathan Cave (RAND), 'Network Neutrality: Challenges and responses in the EU and in the U.S.' available at: http://www.europarl.europa.eu/activities/committees/studies/download.do?language=en&file=36351.

[184] BEREC (2014a), 'BEREC Annual Reports – 2013', BoR (14) 60.

[185] BEREC (2014b), 'Work Programme 2015', BoR (14) 120.

We would like to highlight the following topics as being likely to emerge in the course of negotiations between Council and Parliament. In this analysis, we take our cues primarily the statement of the Hellenic Presidency in May 2014,[186] rather than the less discursive proposal from the Italian Presidency in September 2014.

- **What form of legislative instrument should be used?** This has already been debated within Council.[187] A Regulation may possibly be the best way to prevent divergent approaches in the Member States, but is also less flexible.
- **Irrespective of the form of legislative instrument, does it strike the right balance in preventing harmful divergence among the Member States, while providing appropriate flexibility and respect for subsidiarity?** Is the chosen approach likely to be *effective* in preventing harmful divergence (see Section 5.8)?
- **Are all terms defined with adequate clarity?**
- **Does the instrument strike the right balance in preventing harmful differentiation, while permitting non-harmful differentiation, however defined?** In stakeholder responses to the Commission's 2012 public consultation, there was widespread acknowledgment that it would be harmful for a network operator to differentiate in favour of its own application services (see Section 5.4.8); however, there was a wide range of stakeholder views as to the appropriateness of differentiation for other services, all of which were acceptable to at least some stakeholders (see Section 5.4). Does the legislative instrument distinguish as it must between harmful and non-harmful differentiation? Can it be expected to be effective in preventing the former, while permitting the latter?
- **Does the legislative measure enable appropriate use of *managed services*, and prevent inappropriate use?**[188] Is it indeed meaningful to speak of managed services as being distinct from general Internet services? Are they properly defined? Does the legislative measure permit the use of managed services to the extent that they are not harmful? Is it likely to be effective in preventing harmful use of managed services, while permitting non-harmful or helpful use of managed services? Is there significant risk that managed services might crowd out normal Internet service?
- **Does the legislative measure enable prioritisation of services that legitimately need it, potentially including real time voice and videoconferencing over the public Internet, mission critical services (including public protection and disaster relief (PPDR), and transport), and health?** Is it appropriate to do so? Is the legislative measure effective, appropriate, and efficient in this respect?

[186] Hellenic Presidency (2014), 'Progress Report: Proposal for a Regulation of the European Parliament and of the Council laying down measures concerning the European single market for electronic communications and to achieve a Connected Continent, and amending Directives 2002/20/EC, 2002/21/EC and 2002/22/EC and Regulations (EC) No 1211/2009 and (EU) No 531/2012', 10109/14, 26 May 2014.

[187] 'While all delegations supported the principle of open internet (art. 23), views differed as to whether it is the right moment in time to regulate this issue now and whether to address it in this Regulation or in the Universal Service Directive or to even introduce in a 'soft' instrument, such as Recommendation or BEREC guidelines.' Hellenic Presidency (2014), op. cit.

[188] See also the report of the Hellenic Presidency (2014), op. cit.: 'While delegations agreed that the right balance needs to be struck between net neutrality and reasonable traffic management, they had different views on how to achieve it.'

- **Does the legislative measure do enough to prevent continued impediments to voice over IP (and videoconferencing over IP)?** These impediments are often complex or subtle. This has been a long-standing concern, and was noteworthy in comments of many stakeholders (see Section 5.4.3).
- **Does the legislative measure appropriately balance costs against benefits?** In the absence of a comprehensive, approved Impact Assessment, this remains a wide open question. Legislative measures should consider not only the potential harms associated with quality differentiation, but also the potential benefits (see for instance Section 4.4).
- **Does the legislative measure appropriately balance costs and benefits among the stakeholders?**[189] The Commission's Impact Assessment had identified declining profitability and revenues for the European network operators as one of the problems that the Telecoms Single Market Regulation should seek to correct, yet the network neutrality provisions (like nearly every provision of TSM) increases burdens on network operators.
- **Is the legislative measure sufficiently future proof and technologically neutral?** Internet technology and usage continue to evolve rapidly. It is clearly important that a legislative measure not lock Europe into a structure that risks being quickly outdated. Is the legislative measure overly prescriptive?

[189] See the Hellenic Presidency (2014), op. cit. 'Some delegations also highlighted that the right balance had to be struck also with regard to rights of end users on the one hand and the burden for operators on the other hand.'

REFERENCES

- ARCEP (L'Autorité de Régulation des Communications Electroniques et des Postes) (2010): Internet and network neutrality: Proposals and recommendations, September 2010, available at: http://www.arcep.fr/uploads/tx_gspublication/net-neutralite-orientations-sept2010-eng.pdf.
- BEREC (2014a), 'BEREC Annual Reports – 2013', BoR (14) 60.
- BEREC (Body of European Regulators for Electronic Communications) (2014b), 'Work Programme 2015', BoR (14) 120.
- BEREC (Body of European Regulators for Electronic Communications) (2012a), 'Summary of BEREC positions on net Summary of BEREC positions on net Summary of BEREC positions on net neutrality', BoR (12) 146.
- BEREC (Body of European Regulators for Electronic Communications) (2012b), 'A view of traffic management and other practices resulting in restrictions to the open Internet in Europe: Findings from BEREC's and the European Commission's joint investigation', BoR (12) 30.
- BEREC (Body of European Regulators for Electronic Communications) (2012c), 'Differentiation practices and related competition issues in the scope of net neutrality', BoR (12) 132, 26 November 2012.
- BEREC (Body of European Regulators for Electronic Communications) (2010): 'Response to the European Commission's consultation on the open Internet and net neutrality in Europe', BoR (10) 42, 30 September 2010, http://www.erg.eu.int/doc/berec/bor_10_42.pdf.
- Bykowsky, Mark M., and William W. Sharkey (2014a), Net Neutrality and Market Power: Economic Welfare with Uniform Quality of Service, available on SSRN.
- Bykowsky, Mark M., and William W. Sharkey (2014b), Welfare Effects of Paid for Prioritization Services: A Matching Model with Non-Uniform Quality of Service, available on SSRN.
- Cisco VNI (2014), The Zettabyte Era: Trends and Analysis, 10 June 2014.
- Cisco VNI (2010), Hyperconnectivity and the Approaching Zettabyte Era, 2 June 2010.
- Cooper, Alissa (2013), How Regulation and Competition Influence Discrimination in Broadband Traffic Management: A Comparative Study of Net Neutrality in the United States and the United Kingdom.
- Cremer, J., Rey, P., and J. Tirole (1999): Connectivity in the Commercial Internet.
- Delgrossi, L. and L. Berger (1995), RFC 1819: Internet Stream Protocol Version 2 (ST2).
- European Commission (2013), 'Impact Assessment accompanying the document Proposal for a Regulation of the European Parliament and of the Council laying down measures concerning the European single market for electronic communications and to achieve a Connected Continent, and amending Directives 2002/20/EC, 2002/21/EC and 2002/22/EC and Regulations (EC) No 1211/2009 and (EU) No 531/2012', COM(2013) 627 final, SWD(2013) 332 final, 11 September 2013.

- European Commission (2010), Information Society and Media Directorate-General, Electronic Communications Policy: Questionnaire for the public consultation on the open internet and net neutrality in Europe, 30 June 2010, http://ec.europa.eu/information_society/policy/ecomm/doc/library/public_consult/net_neutrality/nn_questionnaire.pdf.
- European Commission (2014), Digital Agenda Scoreboard, online.
- European Commission (2011), Report on the public consultation on 'The open internet and net neutrality in Europe', 9 November 2010.
- European Commission (2011): 'The open internet and net neutrality in Europe', COM(2011) 222 final, 19 April 2011.
- European Commission (2013), 'Impact Assessment accompanying the document "Proposal for a Regulation of the European Parliament and of the Council laying down measures concerning the European single market for electronic communications and to achieve a Connected Continent, and amending Directives 2002/20/EC, 2002/21/EC and 2002/22/EC and Regulations (EC) No 1211/2009 and (EU) No 531/2012"', 11 September 2013, SWD(2013) 331 final, COM(2013) 627 final, SWD(2013) 332 final.
- European Parliament Impact Assessment Unit (2013), 'Initial appraisal of a European Commission Impact Assessment European Commission proposal on a European single market for electronic communications and to achieve a Connected Continent'.
- Farrell, J., and G. Saloner (1985): Standardization, compatibility and innovation, *RAND Journal of Economics* 16, 70-83.
- FCC (Federal Communications Commission) (2003): In the Matter of Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers; Implementation of the Local Competition Provisions of the Telecommunications Act of 1996; Deployment of Wireline Services Offering Advanced Telecommunications Capability (better known as the Triennial Review Order, or TRO), adopted 20 February 2003, released 21 August 2003.
- FCC (Federal Communications Commission) (2009): In the Matter of Preserving the Open Internet, Broadband Industry Practices, GN Docket No. 09-191, WC Docket No. 07-52, October 22, 2009, http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-09-93A1.doc.
- FCC (Federal Communications Commission) (2010): Internet Access Services: Status as of June 30, 2010.
- FCC (Federal Communications Commission) (2010), National Broadband Plan, March 2010.
- FCC (Federal Communications Commission) (2010): In the Matter of Preserving the Open Internet; Broadband Industry Practices; GN Docket No. 09-191, WC Docket No. 07-52, 23 December 2010.
- FCC (Federal Communications Commission) (2014), In the Matter of Protecting and Promoting the Open Internet, GN Docket No. 14-28, 15 May 2014.
- Gries, C. and I. Philbeck (2013): Marktentwicklung im Bereich Content Delivery Networks (Market developments in Content Delivery Networks), WIK-Diskussionsbeitrag No. 376, April 2013.
- Hellenic Presidency of the Council (2014), 'Progress Report: Proposal for a Regulation of the European Parliament and of the Council laying down measures concerning the European single market for electronic communications and to achieve a Connected Continent, and amending Directives 2002/20/EC, 2002/21/EC and 2002/22/EC and Regulations (EC) No 1211/2009 and (EU) No 531/2012', 10109/14, 26 May 2014.

- Horrigan, J. B. US FCC: Broadband Adoption and Use in America, OBI Working Paper Series Number 1.
- Hotelling, H.: Stability in Competition, *The Economic Journal*, March 1929, pages 41-57.
- IETF (1981), Internet Protocol, RFC 791.
- IETF (1980), User Datagram Protocol, RFC 768.
- IETF (1981), Transmission Control Protocol, RFC 793
- Isenberg, D.: The Rise of the Stupid Network (1 August 1996), available at: http://www.rageboy.com/stupidnet.html (viewed 10 April 2011).
- ITU (International Telecommunication Union): General Recommendations on the transmission quality for an entire international telephone connection (05/2003).
- Kang, Cecilia (2011): House votes to stop FCC funding for net neutrality, 17 February 2011, available at: http://voices.washingtonpost.com/posttech/2011/02/house_votes_to_stop_funds_for.html.
- Katz, M., and C. Shapiro (1985): Network externalities, competition, and compatibility, American Economic Review 75, 424-440.
- Hisashi Kobayashi (1978), *Modeling and Analysis: An Introduction to System Performance Methodology*, Addison-Wesley.
- Kuipers, F. A., Kooij, R. E., De Vleeschauwer, D. and K. Brunnstrom: Techniques for Measuring Quality of Experience, Proc. of the 8th International Conference on Wired/Wireless Internet Communications (WWIC 2010), Lulea, Sweden, June 1-3, 2010, LCNS 6074, pp. 216-227, 2010.
- Laffont, J.-J., Marcus, J. S., Rey, P. and J. Tirole, IDE-I, Toulouse: Internet interconnection and the off-net-cost pricing principle, *RAND Journal of Economics*, Vol. 34, No. 2, Summer 2003, available at: http://www.rje.org/abstracts/abstracts/2003/rje.sum03.Laffont.pdf.
- Laffont, J.-J.and J. Tirole: *Competition in Telecommunications*, 2001.
- Marcus, J. Scott (2002): The Potential Relevance to the United States of the European Union's Newly Adopted Regulatory Framework for Telecommunications, Federal Communications Commission (FCC) Office of Strategic Planning and Policy Analysis (OSP) Working Paper 36, July 2002, available at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-224213A2.pdf.
- Marcus, J. Scott (2004): Evolving Core Capabilities of the Internet, *Journal on Telecommunications and High Technology Law*, 2004, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=921903.
- Marcus, J. Scott (2005): Is the U.S. Dancing to a Different Drummer?, in: *Communications & Strategies*, no. 60, 4th quarter 2005. Available at: http://www.idate.fr/fic/revue_telech/132/CS60%20MARCUS.pdf.
- Marcus, J. Scott (2006): Framework for Interconnection of IP-Based Networks – Accounting Systems and Interconnection Regimes in the USA and the UK, 27 March 2006, available at: http://www.bundesnetzagentur.de/media/archive/6201.pdf.
- Marcus, J. S., Elixmann, D., Carter, K. R., and senior experts Bradner, S., Hackbarth, K., Jullien, B., Kulenkampff, G., Neumann, K.-H., Portilla, A., Rey, P., and. Vogelsang., I. (2008): The Future of IP Interconnection: Technical, Economic, and Public Policy Aspects, March 2008, a study prepared for the European Commission, available at: http://ec.europa.eu/information_society/policy/ecomm/doc/library/ext_studies/future_ip_intercon/ip_intercon_study_final.pdf.

- Marcus, J. Scott, et al. (2009): Network Neutrality: Implications for Europe, WIK, January 2009.
- Marcus, J. Scott (2010): New Directions for U.S. Telecommunications Regulation? The Comcast decision and the 'Third Way', presented at ITS Europe, Copenhagen, September 2010, available at: http://ssrn.com/abstract=1656570.
- Marcus, J. Scott (WIK), Pieter Nooren (TNO) and Jonathan Cave (RAND) (2011), 'Network Neutrality: Challenges and responses in the EU and in the U.S.' available at: http://www.europarl.europa.eu/activities/committees/studies/download.do?language=en&file=36351.
- McDiarmid, Andrew, and Matthew Shears (2013), 'The Importance of Internet Neutrality to Protecting Human Rights Online', in *The Value of Network Neutrality for the Internet of Tomorrow*, Dynamic Coalition for Network Neutrality.
- MIT QoS WG: Inter-provider Quality of Service, White paper draft 1.1, 17 November 2006, available at: http://cfp.mit.edu/publications/CFP_Papers/Interprovider%20QoS%20MIT_CFP_WP_9_14_06.pdf.
- NRIC V, Focus Group 4 (2001), Interoperability: Service Provider Interconnection for Internet Protocol Best Effort Service.
- NTIA (part of the US Department of Commerce) (2014), Broadband Statistics Report, http://www.broadbandmap.gov/download/TechnologyBySpeedDec2013_updated.pdf.
- Obama, Barack (2014), 'Net Neutrality: President Obama's Plan for a Free and Open Internet', at http://www.whitehouse.gov/net-neutrality, viewed 23 November 2014.
- Odlyzko, Andrew (2004): The evolution of price discrimination in transportation and its implications for the Internet, Review of Network Economics, vol. 3, no. 3, September 2004, pp. 323-346.
- OECD (2014), Broadband Portal, at: http://www.oecd.org/sti/broadband/oecdbroadbandportal.htm.
- Pathan, M., Buyya, R., and A. Vakali: Content Delivery Networks: State of the Art, Insights, and Imperatives, Lecture Notes in Electrical Engineering, Springer, 2008, Volume 9, Part I, 3-32.
- Reuters (2014), 'Brazilian Congress Passes Internet Bill of Rights'.
- Rochet, J.-Ch., and J. Tirole (2004): Two Sided Markets: An Overview, March 2004, available at: http://faculty.haas.berkeley.edu/hermalin/rochet_tirole.pdf.
- Rohlfs, J. H. (2003): Bandwagon Effects in High Technology Industries, MIT Press, 2003.
- Saltzer, J., Reed, D., and D. D. Clark: End-to-End Arguments in System Design. Second International Conference on Distributed Computing Systems, pages 509-512, April 1981. ACM Transactions on Computer Systems, 2(4), pages 277-288, 1984.
- Schechner, Sam, and Ryan Knutson (2014), 'Telecoms Step Up Fight Over Net Neutrality', *Wall Street Journal*, 24 February 2014.
- Swedish Post and Telecom Agency: Open networks and services, Report Number: PTS-ER-2009:32 (30 November 2009) http://www.pts.se/upload/Rapporter/Internet/2009/2009-32-open-networks-services.pdf.
- Takahashi, A., Hands, D., and V. Barriac: Standardization activities in the ITU for a QoE assessment of IPTV, *Communications Magazine, IEEE* , vol.46, no.2, pp.78-84, February 2008 doi: 10.1109/MCOM.2008.4473087.

- TNS Opinion & Social (2010), Special Eurobarometer 335, Fieldwork: November - December 2009; Publication: October 2010; on behalf of the European Commission, Directorate-General Communications Networks, Content and Technology.
- TNS Opinion & Social (2013), Special Eurobarometer 396: E-COMMUNICATIONS HOUSEHOLD SURVEY REPORT; Fieldwork: February - March 2013, Publication: November 2013, on behalf of the European Commission, Directorate-General Communications Networks, Content and Technology.
- United States Court of Appeals for the District of Columbia Circuit (2010): Comcast vs FCC, argued 8 January 2010, decided 6 April 2010, No. 08-1291.
- United States Court of Appeals for the District of Columbia Circuit (2014), Verizon v. FCC, 740 F.3d 623 (D.C. Cir. 2014).
- Vakali, A., and G. Pallis: Content delivery networks: status and trends, Internet Computing, IEEE, vol.7, no.6, pp. 68- 74, Nov.-Dec. 2003, doi: 10.1109/MIC.2003.1250586.
- van Schewick, Barbara (2014), 'Network Neutrality and Quality of Service: What a Non-Discrimination Rule Should Look Like', Stanford University Public Law and Legal Theory Working Paper Series: Research Paper No. 2459568, John M. Olin Program in Law and Economics Working Paper Series: Paper No. 462, Stanford Law Review, Volume 67, Issue 1 (2015) (forthcoming).
- Verizon (2011): Verizon Files Appeal in Federal Court Regarding FCC Net Neutrality Order, Press Release, 20 January 2011, http://newscenter.verizon.com/press-releases/verizon/2011/verizon-files-appeal-in.html.
- Vijay Kumar Adhikari, Yang Guo, Fang Hao, Matteo Varvello, Volker Hilt, Moritz Steiner and Zhi-Li Zhang (2012), 'Unreeling Netflix: Understanding and Improving Multi-CDN Movie Delivery'.
- Walker, Lauren (2014), 'How is Net Neutrality Working for the Countries That Have It?', *Newsweek*.
- Weller, Dennis, and Bill Woodcock (2012), 'Internet Traffic Exchange: Market Developments and Policy Challenges', OECD.

EUROPEAN PARLIAMENT

CAT: QA-06-14-221-EN-C (paper)
CAT: QA-06-14-221-EN-N (pdf)

DIRECTORATE-GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT A
ECONOMIC AND SCIENTIFIC POLICY

Role

Policy departments are research units that provide specialised advice to committees, inter-parliamentary delegations and other parliamentary bodies.

Policy Areas

- Economic and Monetary Affairs
- Employment and Social Affairs
- Environment, Public Health and Food Safety
- Industry, Research and Energy
- Internal Market and Consumer Protection

Documents

Visit the European Parliament website: **http://www.europarl.europa.eu/studies**

PHOTO CREDIT: iStockphoto.com; Shutterstock/beboy

ISBN 978-92-823-6328-7 (paper)
ISBN 978-92-823-6327-0 (pdf)

doi: 10.2861/762659 (paper)
doi: 10.2861/014374 (pdf)

Publications Office

Network Neutrality Revisited: Challenges and Responses in the EU and in the US