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Network Neutrality and Competition between Networks: a Brief Sketch of the Issues

Users of the Internet benefit from a stream of continuously emerging innovations in applications and services. These innovations give rise to a need for faster and more precise data transmission, which requires investments and innovations by network operators. Certain innovations, such as Quality of Service (QoS) and the labeling of individual data packets (packet shaping), help operators to raise the priority of a certain data flow or limit the priority of another flow. Such technologies may support the provision of applications that are time-sensitive (e.g. voice), or that require high bandwidth (e.g. video) or a higher level of security (e.g. e-commerce).

The Internet as we currently know it is based on a simple network architecture,[1] which allows any computer to send packets to any other computer, while packets are not inspected by the networks. As a result, all packets are treated in the same way, and in case of congestion, packets are treated on a first-in/first-out basis ("best effort" routing practice). Moreover, literally anyone is able to build, implement and introduce (possibly as commercial services) new Web applications, without having to ask any party, such as an Internet service provider (ISP) or network operator, for permission. Thus, the Internet, as it is based on freedom of connection with any application or service, and to any party, can be seen as a neutral communications medium; it is characterized by "network neutrality".[2]

There is no precise definition of network neutrality – the concept is largely based on the four "Internet Freedoms" formulated by Michael Powell,[3] then chairman of the Federal Communications Commission (FCC), to conclude a discussion on the 1996 US Telecommunications Act: consumers should be able to have access to lawful internet content, to run applications and services of their choice, to attach devices to their connection, and to receive transparent information regarding network operators. There is however a consensus in all approaches saying that the Internet should be operated under non-discrimination and should protect interconnection and end-to-end connectivity.

The neutral architecture of the Internet is being challenged by various parties, such as network operators providing the connections to end-users, who are strongly interested in gaining control of the information exchanged over the Internet. Such control would give them the possibility, for instance, to charge different prices for different types of information carried over their networks, to differentiate between QoS for different applications, and to block certain applications from their networks. Potentially, the impact on competition and the value derived by consumers of such behavior may be very large.

It also means that at some point differentiation could become a successor to the current "best-effort" practice, and even though the Internet currently exhibits excess capacity,[4] a packet might be dropped out of the data flow according to a network operator's preferences. Changes in regulations also allow certain practices. In the US since 2005 Internet transmissions have been reclassified as "information services", removed from the category of "telecommunications

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1 Based on certain protocols (known as TCP and IP).

2 This description is based on the weblog of Tim Berners-Lee, one of the inventors of the Web, 21 June 2006; http://dig.csail.mit.edu/breadcrumbs/taxonomy/term/23.

3 M. K. Powell: Remarks at the Silicon Flatirons Symposium on 'The Digital Broadband Migration: Toward a Regulatory Regime for the Internet Age', University of Colorado School of Law, Boulder, Colorado, 8 February 2004, http://www.cdt.org/speech/net-neutrality/20040208powell.pdf.

4 See J. Prüfer, E. Jahn: Dark Clouds over the Internet?, in: Telecommunications Policy, Vol. 31 (3-4), 2007, pp. 144-154.

services", and hence are no longer subject to the non-discrimination clause. These changes have stirred the heated debate on "network neutrality", particularly in the US. This debate is now gaining prominence in Europe as well; however, the starting-point in the discussion is slightly rephrased due to the fact that local-loop-unbundling was more successful in Europe than in the US, creating sufficient competition at the last mile of Internet access provision.[5] However this different characteristic has not decreased the importance of the fact that ISPs may still have incentives to engage in prioritizing practices.

The main questions in the debate on network neutrality relate to the private incentives and the social costs and benefits caused by active packet shaping: how is competition affected? How are consumer choice and consumers' surplus affected? How are the incentives to invest and innovate – in networks as well as applications and services – affected? The first two questions are particularly relevant for short-term, the latter for long-term welfare.

There are a few things that make the discussion more complicated: one can witness very fast technological development and also changes in the business models of internet-based firms. At the moment nobody can predict how the next generation network (NGN) will function, and according to participants in the discussion, the market should sort out the outcome.[6] Conflicting opinions also lie in the assessment whether the currently witnessed success of the Internet is due to innovations at the "edges" of the network or rather in the "core". Here, the core refers to intelligence inside of the network, while the edges correspond to functionality that end-users can implement themselves. Furthermore, from the subscriber-based characteristics of telecommunications networks, a shift can be observed towards a model relying on tailor-made advertisements, thereby potentially rearranging the structure of revenues gained in the broadband market.

In the current debate on network neutrality, two main streams of reasoning conflict mainly on the basis of legal and political arguments.[7] Nonetheless, the problem needs to be analyzed on the basis of economic theory, and by doing so, a more realistic assessment of the problem will most likely be found between these two streams.

In this paper, we provide an outline of the type of economic modeling that can address network neutrality, as well as of the type of results that can be expected. In our welfare analysis we mainly focus on access-tiering in the presence of facilities-based competition and horizontal service differentiation. The latter characteristic is relevant since it is sometimes claimed that as long as consumers can choose between networks, they can always switch if they do not like operators' initiatives to reduce network neutrality (we will come back to this claim in the body of the paper).

A few analytical papers on net neutrality have already been written. Some of them provide overall economic analysis, although they use little or no economic modeling. The closest paper to our conclusions is van Schewick[8] who argues that even in a duopoly situation network operators have incentives to discriminate, which leads to the exclusion of applications and content providers and thus to a lack of innovations at that level. She also claims that due to net neutrality regulation, the decreasing incentives to invest in networks would be outweighed by the benefits from application-level innovation. One of the main differences from our paper relates to this point. By assessing network-level investments in a set-up which distinguishes the ef-

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[5] See C. Marsden, J. Cave: Price and quality discrimination in next generation internet access: Beyond the 'net neutrality' debate. Prepared for ITS Europe meeting, 2007, http://www.itseurope.org/ITS%20CONF/istanbul2007/downloads/paper/11.08.2007_Marsden_Cave_Net_neutrality.doc.

[6] See J. S. Marcus: Interconnection on an IP-based NGN Environment. A chapter in ITU's Global Trends 2007, 2007, http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR07/discussion_papers/JScott_Marcus_Interconnection_IP-based.pdf, for an extensive overview on NGN networks and relating regulatory challenges.

[7] Proponents are e.g. T. Berners-Lee: Testimony before the US House of Representatives Committee on Energy and Commerce Subcommittee on Telecommunications and the Internet Hearing on the Digital Future of the US: Part I – The Future of the World Wide Web 1 March 2007, http://energycommerce.house.gov/cmte_mtgs/110-ti_hrg.030107.WorldWideWeb.shtml; S. P. Crawford: The Internet and the Project of Communications Law, Mimeo, Cardozo School of Law, 2007, http://ssrn.com/abstract=962594; R. Frieden: Network Neutrality or Bias? Handicapping the Odds for a Tiered and Branded Internet, in: Hastings Communications and Entertainment Law Journal, Vol. 29, No. 2, 2006, pp. 171-216; L. Lessig: Testimony before the Senate Committee on Commerce, Science and Transportation Hearing on Network Neutrality, 7 February 2006, http://commerce.senate.gov/hearings/witnesslist.cfm?id=1705; and T. Wu: Network Neutrality, Broadband Discrimination, in: Journal on Telecommunications and High Technology Law, Vol. 2, 2003, pp. 141-178. Opponents include R. E. Litan, H. J. Singer: Unintended Consequences of Net Neutrality Regulation, in: Journal on Telecommunications and High Technology Law, Vol. 5, No. 2, 2007, pp. 533-572; G. Sidak: A Consumer-Welfare Approach to Network Neutrality Regulation of the Internet, in: Journal of Competition Law and Economics, Vol. 2, No. 3, 2006, pp. 349-474; L. Waverman: Comments on Network Neutrality, in: Journal of Competition Law and Economics, Vol. 2, No. 3, 2006, pp. 475-477; and C. Yoo: Beyond Network Neutrality, Vanderbilt University Law School Public Law & Legal Theory, Working Paper 05-20 and Law & Economics Working Paper 05-16, 2005. For more details in the discussion cf. V. Kocsis, P. W. J. Bijl: Network neutrality and the nature of competition between network operators, in: International Economics and Economic Policy, Vol. 4, No. 2, 2007, pp. 159-184.

[8] B. van Schewick: Towards an Economic Framework for Network Neutrality Regulation, in: Journal on Telecommunications and High Technology Law, Vol. 5, 2007, pp. 329-392.

fects of horizontal differentiation from rent capturing, our welfare analysis shows that overall welfare will not necessarily decrease in the presence of discrimination. Hahn and Wallsten[9] stand for a rather "hands-off" approach, yet they agree with network neutrality proponents that exclusion may occur which will harm consumers. However, they claim that net neutrality regulation, which they consider as a type of price regulation, would also harm welfare. Instead, they suggest that policy should focus on reducing upstream entry barriers, and that the government should continue to play an important role in antitrust enforcement.

To support our results for blocking and quality degradation, we rely on the economics of sabotage in vertically integrated markets. For instance Mandy and Sappington[10] show that under access regulation a monopoly network has an incentive to degrade the quality of the access line of its rival application providers. However, as is shown in Bijlsma et al.[11], a non-regulated network will not engage in sabotage independently of the type of contract offered to application providers.

Still relatively few papers model prioritization in the broadband Internet market. As Cheng et al.[12] show, network operators are interested in discriminating strategies, and even though consumers are never worse off, short-term total welfare may decrease due to the foreclosure of application providers.[13] Hermalin and Katz[14] adopt a framework of two-sided markets and find that under prioritization low-quality service providers are excluded from the market, those with medium valuation enjoy a higher and more efficient quality than under net neutrality, and finally the top of the market utilizes a lower and less efficient quality. The overall welfare effect of prioritization tends to be negative, even in case of duopoly networks. Choi and Kim[15] analyze long-run welfare by considering the investment decisions of both a monopoly network and competing application providers. They find that application providers have higher incentives to invest under a neutral regime, but the welfare effects of net neutrality regulation on the network's investment incentives are ambiguous.

Regulatory authorities, such as Ofcom in the UK and FCC or FTC in the US, and international organizations, like the OECD[16] have recently started to participate actively in the discussion. At present they share the view that regulatory intervention should remain minimal and limited to *ex post* intervention in case of anticompetitive practices. However, intensifying competition and providing transparency for the benefit of consumers are still two of the most important policy goals which can be supported by *ex ante* regulation.

It is beyond the scope of this paper to provide recommendations on the optimal way of implementing network neutrality, but it is nevertheless worthwhile to point out some legal issues in the EU.[17] Firstly, in the European Union the wholesale broadband access market falls under the significant market power (SMP) regime regulated in the Access Directive.[18] If we assume that this market definition adequately covers the problem, then operators with SMP on this market could face certain obligations, including non-discrimination and access at regulated prices. Secondly, in the Access Directive interconnection and interoperability (Articles 4 and 5) have been set as principles, although no other specific enforceable regulation for interconnection and interoperability exists. Interconnection is based on negotiation, and the outcome depends on the bargaining power of the participants. Some issues falling under "network neutrality" could perhaps be dealt with under this heading. However, the power of the national regulatory authorities in these questions is limited, which calls for reconsidering their role.

The structure of our paper is as follows. First we introduce potential discriminatory practices and the framework we will use to explore network neutrality from an economics viewpoint. Using this framework,

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9 R. W. Hahn, S. Wallsten: The Economics of Net Neutrality, AEI-Brookings Joint Center Working Paper No. RP06-13, 2006.

10 D. M. Mandy, D. E. M. Sappington: Incentives for Sabotage in Vertically-Related Industries, in: Journal of Regulatory Economics, Vol. 31, 2007, pp. 235-260.

11 M. Bijlsma, P. W. J. de Bijl, V. Kocsis: Incentives for sabotage in network industries, Mimeo, CPB Netherlands Bureau for Economic Policy Analysis, 2008.

12 H. K. Cheng, S. Bandyopadhyay, H. Guo: The Debate on Net Neutrality: A Policy Perspective, Mimeo, Department of Information Systems and Operations Management, Warrington College of Business Administration, University of Florida, 2007.

13 N. Economides, J. Tåg: Net Neutrality on the Internet: A Two-sided Market Analysis, Mimeo, Stern School of Business, NYU and Swedish School of Economics and Business Administration, FDPE, and HECER, 2007, modeling the two-sided nature of the market, also find decreasing short-term welfare as a result of prioritization.

14 B. E. Hermalin, M. L. Katz: The economics of product-line restrictions with an application to the network neutrality debate, in: Information Economics Policy, Vol. 19, 2007, pp. 215-248.

15 J. P. Choi, B.-C. Kim: An Economic Analysis of Net Neutrality and Investment Incentives, Mimeo, Michigan State University, 2007.

16 Cf. e.g. OECD: Internet Traffic Prioritisation: An Overview, DSTI/ICCP/TISP(2006)4/FINAL, 2006, http://www.oecd.org/dataoecd/43/63/38405781.pdf; and for further references, V. Kocsis, P. W. J. Bijl, op. cit.

17 For a complete analysis cf. F. Chirico, I. van der Haar, P. Larouche: Network Neutrality in the EU, Mimeo, TILEC Tilburg University, 2007.

18 European Commission: Directive 2002/19/EC of the European Parliament and of the Council of 7 March 2002 on access to, and interconnection of, electronic communications networks and associated facilities, Official Journal of the European Communities L 108/7, 2002.

the most relevant discriminating practices are then analyzed, including the assessment whether in case of high social costs policy tools which already exist are sufficiently effective to avoid them. Access-tiering receives special attention. Finally some preliminary policy recommendations are presented.

Background and Analytical Framework

The main types of behavior that violate network neutrality are the following:

- *Port blocking and quality degradation*: Using new technologies, a network owner is able to block access to, or deliberately degrade the quality of, data transmission from a website providing applications, services or content. In an extreme case both operators may block part of the internet for some end-users. In practice port blocking has already occurred, particularly relating to voice over internet protocol (VoIP) services.[19]
- *Access-tiering*: A network operator may discriminate by giving bandwidth priority at a price independent from internet access fees to application, service and content providers that are willing to pay for quality of services. Network operators may auction off or sell lanes to application and service providers in order to capture rents from their producer surplus.

In addition, due to its discriminating characteristic, "consumer-tiering" is sometimes viewed as violating network neutrality. A network operator may offer different types of access contracts, based on differences in speed and volume, and sell them at different prices according to consumers' willingness to pay. However, we view this practice as an example of price discrimination where a consumer decides which package to choose and pays according to her preferences, similar to, for instance, the availability of different types of contracts in mobile telephony. Therefore consumer-tiering does not seem to be controversial in the current debate on network neutrality.

The starting-point for our analysis will be a hypothetical situation in which (i) there is network neutrality (this corresponds to the internet as we currently know it); and (ii) there is effective competition between a small number of network operators (this may depend on the presence of network neutrality, as we will later see).[20, 21]

Figure 1
Illustration of Market Participants

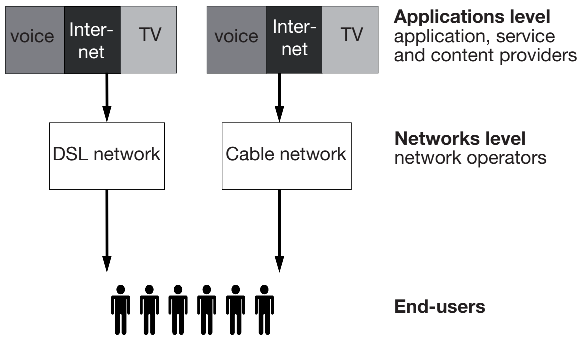


Figure 1 illustrates the situation we consider, with a networks level and an applications (or services) level. Note that the latter includes "plain" broadband access as a service in itself. End-users are the users of applications and services and can be consumers as well as producers; both are paying fees for having internet access.

By looking at what happens if network neutrality is abandoned in various ways, we will consider what happens to the effectiveness of competition and to welfare. To evaluate the emerging situations from a policy perspective, we loosely follow the approach developed in Bennett et al.[22] To do so, we will judge market outcomes and policy interventions by the criteria of static and dynamic efficiency. Higher static efficiency arises from an improved allocation of inputs by using existing technologies, while higher dynamic efficiency comes from investments in process innovation in order to lower costs of service provision (in telecoms this is typically done by investing in new types of equipment and infrastructure) and product innovation to provide new and improved services (or higher speed) representing higher consumer value, both leading therefore to innovations that are welfare-increasing. All this is valid to the extent that such invest-

[19] For an example in the US context, see the decision in the Madison River case which passed in March 2005 at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-05-543A2.pdf. A European example concerns the announcement by Vodafone Germany (July 2005) that it would block Skype services via its 3G network from July 2007; see e.g. http://www.ovum.com/go/content/c,57072.

[20] For the sake of brevity, we will not discuss recent developments in the broadband market. For a recent overview of developments in broadband, cf. P. W. J. de Bijl, M. Peitz: Broadband Access in Europe: Challenges for Policy and Regulation, CESifo DICE Report, 3/2006.

[21] The situation in the Netherlands provides an example. When we talk about network operators, we include companies with their own infrastructure (network owners) and internet service providers (ISPs) that use this infrastructure. To simplify the analysis, we treat local loop unbundling and bitstream access on the same level as the network owners.

[22] M. Bennett, P. W. J. de Bijl, M. Canoy: Future Policy in Telecommunications: An Analytical Framework CPB Document No. 005, CPB Netherlands Bureau for Economic Policy Research, 2001; P. W. J. de Bijl: Competition, Innovation and Future-proof Policy, TILEC Paper, Tilburg University, 2004, http://www.tilburguniversity.nl/tilec/publications/report/policy.pdf, contains an accessible summary, which is useful for readers who are unfamiliar with this approach.

ments are not wasteful but lead to higher total surplus. Thus, static efficiency is a short-run welfare notion, and dynamic efficiency a long-run one. Outcomes that maximize dynamic efficiency at the expense of (short-run) efficiency generally outperform – in terms of the aggregate of per period welfare levels in the long run – the outcomes that maximize static efficiency at the expense of dynamic efficiency.

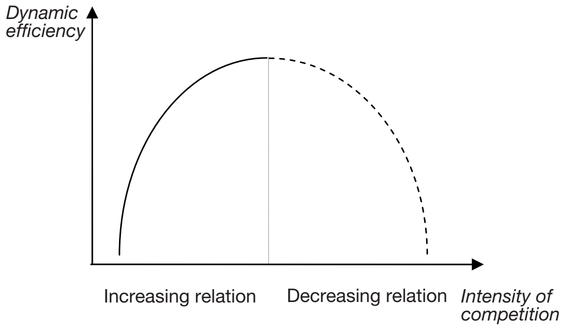
We make three assumptions:

1. Application innovations at the edges are more important for dynamic efficiency than centralized innovations within networks.
2. Facilities-based competition at the networks level is characterized by a small number of networks, while more competition increases dynamic efficiency.
3. Network providers have incentives to horizontally differentiate their networks.

These assumptions are not purely hypothetical, as they are supported by empirical or theoretical considerations.

Assumption 1: According to Odlyzko,[23] one of the misleading myths in the telecoms sector is that networks are able to develop innovative services. Although networks have been very innovative in improving their transport technologies, virtually all "killer applications" running over the networks have come from users of their networks and not from the carriers themselves. Odlyzko and also Berners-Lee[24] argue that, because of convergence, the fraction of innovations coming from users at the edges of the networks will increase even further. In any case there is no reason to suspect that network operators can easily turn this into their core business, let alone at a level comparable to innovation generated through decentralized processes.[25] Somewhat more generally, as one of the internet's central features is user connectivity, it is this particular feature that will stimulate (decentralized) innovation more and more.[26] It is exactly this type of innovation – bottom-up, decentralized and fragmented, aided by the enormous communication power of the internet – that generates the largest number of ideas, as it is users who do the experimentation and subsequent filtering of ideas themselves.

Figure 2
Relationship between Competition and Dynamic Efficiency



Assumption 2: Another important point in the network neutrality discussion is whether the network owners have enough incentives to invest in upgrading, maintenance or rollout of infrastructure. To assess the welfare relating to the networks level, potential trade-offs between static and dynamic efficiency will be taken into account by adopting the "inverse U-shaped" relationship between the intensity of competition and dynamic efficiency,[27] as depicted in Figure 2.

We claim that the current level of competition is located in the left-hand part of the inverse U-shaped curve, that is with an increasing relationship between competition and regulation. Later in the analysis we will refer only to this part of the curve.

Assumption 3: One of the root causes of the network neutrality discussion was the statement by Ed Whitacre, CEO of AT&T when he openly expressed the will to discriminate.[28] Since then other telecoms have given voice to similar opinions in the news.[29] Theoretical evi-

[23] A. Odlyzko: Telecom dogmas and spectrum allocation, Mimeo, Digital Technology Center, University of Minnesota, 2004, http://www.dtc.umn.edu/~odlyzko/doc/telecom.dogmas.spectrum.pdf

[24] T. Berners-Lee, op. cit.

[25] Of course there are situations in which centralized planning is superior to decentralized decision-making, but this is most likely not the case in situations with a lot of technological change and uncertainty. Cf. T. Wu: Intellectual Property, Innovations, and Decentralized Decisions, in: Virginia Law Review, Vol. 92, 2006, pp. 101-127, who discusses the relative efficiency of polyarchies and hierarchies as decision-making models.

[26] E. von Hippel: Democratizing Innovation, Cambridge MA 2005, MIT Press; and Y. Benkler: The Wealth of Networks: How Social Production Transforms Markets and Freedom, New Haven, London 2006, Yale University Press.

[27] P. Aghion, N. Bloom, R. Blundell, R. Griffith, P. Howitt: Competition and Innovation: An Inverted-U Relationship, in: Quarterly Journal of Economics, Vol. 120, No. 2, 2005, pp. 701-728.

[28] See http://www.businessweek.com/@@n34h*IUQu7KtOwgA/magazine/content/05_45/b3958092.htm.

[29] Cf. S. P. Crawford, op. cit.; and other examples such as V. Vittore: Cable flying under net neutrality radar, Telephony Online, 6 March, 2006, about cable companies, http://telephonyonline.com/mag/telecom_cable_flying_net/; D. Searcy, A. Schatz: Phone Companies Set Off a Battle Over Internet Fees, in: Wall Street Journal, 6 January 2006, about Verizon, http://www.freepress.net/news/13218; BellSouth about net neutrality, 3 April 2006, http://slashdot.org/article.pl?sid=06/03/06/003204; Joseph Waz: Keynote Remarks, Broadband Policy Summit, Washington, DC, 10 May 2006, http://www.ncta.com/DocumentBinary.aspx?id=357; J. Sherman: Expanded Alliance Makes BellSouth DSL Service Available to DirecTV Subs, 14 February, 2006, about DSL-satellite deals, http://www.tvweek.com/news.cms?newsId=9390.

Figure 3
Port Blocking and Quality Degradation by Operator 1

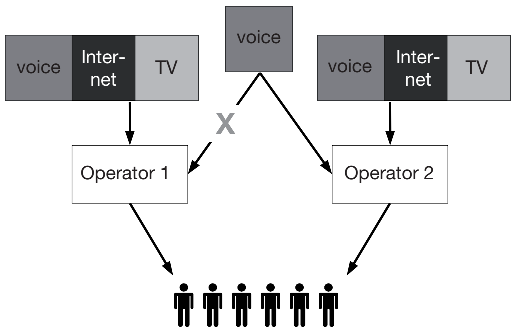
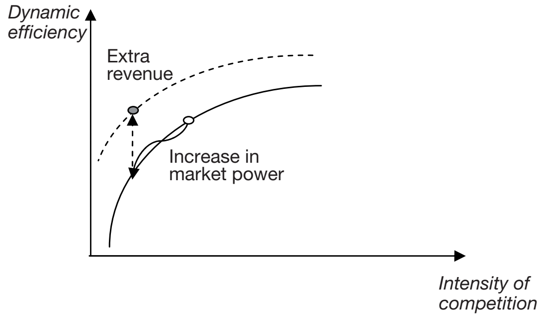


Figure 4
Change in Dynamic Efficiency at the Networks



dence can also be found behind networks' incentive to differentiate themselves from each other. According to Farrell and Weiser,[30] a network operator is interested in vertical control of the application market when it wants to be engaged in price discrimination. By setting different prices for a bundle of the platform and particular applications, it can customize its offer to the buyers, separating those consumers who are willing to pay more (inframarginal consumers) from those who would switch for a price increase (marginal consumers). In case of consumers as end-users, this situation can be translated to consumer-tiering, and while application providers act as end-users, this corresponds to access-tiering. Stennek[31] also argues that network operators are interested in exclusive deals with application providers in the comparable applications market when the quality of services can be increased.

Benchmark Case

In the current situation of network neutrality, which serves as our benchmark case, services and applications are provided in a non-discriminative manner. By buying internet access, consumers can use or purchase all available services, applications and content (as illustrated in Figure 1). In addition, they can develop applications themselves (not depicted in the figure). Therefore the market outcome is as if consumers are able to contract directly with application or service providers; it is as if the market is homogeneous at the networks level.

As discussed above, we can observe the most important application-level innovations and investments occurring at the edges. Moreover, there is effective facilities-based competition between network operators, and we assume that there is no wasteful duplication of investments in networks. Therefore our starting-point seems to be characterized by both relatively high static and high dynamic efficiency.

Port Blocking and Quality Degradation

To dive into the potential practices that may harm network neutrality, let us first look at port blocking and quality degradation, as depicted in Figure 3.

A network operator may have an incentive to discriminate when it provides or sponsors a service that competes directly with the blocked site (e.g. fixed telephony vs. VoIP), but its incentives depend on whether the market is subject to regulation or not. Mandy and Sappington[32] present the incentives for increasing access costs and degrading application quality in a market with a regulated vertically integrated monopolist if quality matters for consumers. By blocking the competing service or degrading the quality of lanes used by that particular service, the network operator's customers will use its own service, resulting in a monopoly position over its customer basis and at the same time in a more stable market share. Due to the first effect, the network operator may increase its prices, and so its revenue captured in the market for services and applications. The second effect, that is the stable market share and the relating positive network externalities (a consumer's utility increases with an increase in the total number of consumers using the same product or service), helps the firm attract more advertisers, thus increasing its outside revenues.

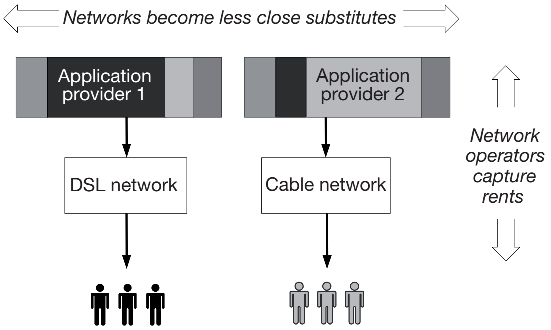
In the presence of insufficient facilities-based competition and access regulation, blocking and quality degradation can therefore be seen as an effective anti-competitive practice. Application developers may eas-

[30] J. Farrell, P. J. Weiser: Modularity, Vertical Integration, and Open Access Policies: Towards a Convergence of Antitrust and Regulation In the Internet Age, in: Harvard Journal of Law & Technology, Vol. 17, No. 1, 2003, pp. 85-134. Let us note that the authors explain their view about vertical leverage in a monopoly setup.

[31] J. Stennek: Exclusive Quality – Why Exclusive Distribution May Benefit the TV Viewers, CEPR Discussion Paper No. 6072, 2007.

[32] D. M. Mandy, D. E. M. Sappington, op. cit.

Figure 5
Access-tiering Leading to Product Differentiation and Rent Capturing



ily lose incentives to innovate and invest by the threat of being blocked, thus decreasing both static and dynamic efficiency. At the networks level, the above mentioned sources may give enough incentives for network operators to invest, thus increasing dynamic efficiency. This effect can be illustrated as an upward shift of the inverted U-shaped curve (the dashed line in Figure 4). On the other hand, network operators may become "lazy monopolists" in the achieved market position – that is moving leftwards on the inverted U-shaped curve – and cease to invest, resulting in decreased long-term welfare. Whether the new outcome – depicted by a grey dot – exhibits higher dynamic efficiency or not depends on how these two effects relate to each other.

By analyzing the incentives of a non-regulated incumbent, Bijlsma et al.[33] find the opposite. Independently of the type of access contract offered to the rival firm no sabotage takes place. However, if sabotage is very cheap, by offering a non-linear contract the monopoly is only able to set a higher access price than its profit maximizing one, otherwise it cannot commit not to engage in sabotage.

One may ask whether in case of sufficient facilities-based competition a network operator is able to maintain blocking in the longer term. Indeed, customers can walk away and choose another network if they are unhappy with the practice they face. If operator 1 blocks a service or degrades the quality of a line, then another network, say operator 2, may have an incentive not to block it since by providing more product variety or better quality, operator 2 can differentiate itself from operator 1. As a result of differentiation, consumers are willing to pay more and if switching can be executed easily, operator 2 can increase its market share and its internal and external revenue. Therefore operator 1 may reconsider its blocking strategy.

[33] M. Bijlsma, P. W. J. de Bijl, V. Kocsis, op. cit.

If blocking and deliberate quality degradation occur, general competition law should be able to deal with it, as can be seen in practice (e.g. Madison River case). However, the effectiveness of *ex post* intervention crucially depends on the effectiveness of monitoring, detection and punishment. Also, existing policy tools such as facilitating wholesale broadband access, securing easy switch for consumers or requiring interoperability may be sufficient to prevent these anti-competitive practices, under which a network operator cannot maintain its market power without losing too much of its market share. After the static efficiency comparison between the regulated and non-regulated cases, Bijlsma et al.[34] find that the regulator is able to increase welfare by abandoning wholesale regulation if sabotage is cheap for the monopoly and by maintaining regulation if sabotage is expensive. In theory, the ultimate tool to eliminate anticompetitive practices is the vertical separation of the network, that is, preventing it from competing with applications and services altogether.

Access-tiering

Addressing access-tiering is somewhat less straightforward than the case of port blocking. Our starting-point is the recognition that network operators are continuously facing the pressure that their networks are commoditized, selling capacity without any distinguishing functionality, and leaving them with eroded profit margins. As we discussed above, to counteract this pressure, operators basically have two options: (1) to add "flavors" to their services, for instance through QoS-like functionality; and (2) to become gatekeepers that can extract rents from their customers, including application providers and end-users. Access-tiering provides the possibilities to do both. Therefore, the potential effects of access-tiering are twofold (depicted in Figure 5).

- *Horizontal effect*: due to making exclusive deals with application providers, mainly by auctioning off priorities,[35] network operators can distinguish themselves from one another. The result is horizontal differentiation, which allows operators to increase market power and hence mark-ups.[36]

[34] Ibid.

[35] Application and service providers intend to receive higher priority, and the winning bid goes to the one with higher efficiency (cf. J. P. Choi, B.-C. Kim, op. cit.).

[36] Let us note that this problem has to be distinguished from the general horizontal differentiation where consumers have a priori preferences over a particular service or product (e.g. red cars versus black cars). The current type of differentiation is artificially generated by the network operators, and considered as in a Hotelling model (cf. J. Tirole: The Theory of Industrial Organization, Cambridge 1988, The MIT Press).

- *Vertical effect*: given the bargaining power arising from their "gatekeeper" role, network operators can try to extract surplus from application and service providers. Note that this power may be less if there is more intense competition between networks, as application and service providers then have more effective choice for a certain quality.

Arguably, this situation is more likely if there is a smaller number of competing networks. The reason is that with a larger number of competing networks, operators will have a harder time differentiating themselves from one another.

Effects on Static and Dynamic Efficiency

The *networks market* is subject to natural entry barriers such as economies of scale and sunk costs. Hence existing network operators are not immediately threatened by entry if they reduce the intensity of competition through horizontal differentiation. Therefore at the networks level it leads to higher prices for broadband access.

Due to horizontal differentiation consumer choice in the *applications market* is likely to be curtailed since consumers will face less variety of existing (or comparable) services. Originally they had access to all content on each network under the same conditions, whereas in the new situation the choice for a network may imply constrained access to some types of content. Furthermore, not being able to engage in exclusive deals, start-ups may stay outside the market, or companies with small market share may either easily drop out or be forced to merge with larger application providers which leads to higher market concentration. By acquiring smaller firms larger companies can assure or even increase their market power which in case of paying applications and services might lead to higher prices on that market.

For all these reasons we claim that in the presence of access-tiering and exclusive deals, static efficiency will be reduced.[37]

The effect on dynamic efficiency at the *networks level*, due to the horizontal and vertical effects, is not clear-cut. Here a similar argument is valid as in case of blocking (see Figure 4). Therefore before deciding about the type of intervention, policymakers will have to assess the relative magnitude of these two effects.[38] Note also that due to mandatory unbundling, a fringe of DSL entrants without networks imposes intense competition on network operators; product differentiation might then be useful to restore the returns on investment for network operators.[39]

The effect on dynamic efficiency at the *services and applications level* can be separated into, on the one hand, new innovations that have originated from end-users at the edges, and on the other hand, improvements and imitations of already existing services, possibly carried out by network operators.

According to the first assumption we made above, access-tiering is undesirable for dynamic efficiency since developers of the radically new applications – at the edges – will most likely not be able to enter exclusive deals for receiving priorities. Having degraded priority, they face a higher risk of achieving too little critical mass in their customer base to successfully enter the market. The lack of innovation at the edges might be more pronounced in case of high quality applications and services, such as voice and video. Hermalin and Katz[40] claim that by prioritization low value services drop out of the market and high value services receive lower quality than in case of a neutral network.

The other side of the applications market exhibits the adoption of existing innovations (that were originally developed by end-users and small start-ups) by big firms. This market is more competitive with the participation of bigger application providers and network owners. Here, application and service providers receiving priorities may gain a larger and, because of product differentiation, more stable market share, and as a consequence higher external revenues. According to Stennek,[41] under specific conditions these external revenues may give application providers stronger incentives to invest in higher quality of services, resulting in higher market shares which makes their product more attractive to advertisers.

Finally, due to the complementary relation between networks and applications, in case of separate providers, not all the positive effects arising from investments can be obtained by the investor. As a result of these externalities, the firms at both levels will have fewer

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37 N. Economides, J. Tåg, op. cit.; and H. K. Cheng, S. Bandyopadhyay, H. Guo, op. cit., find also decreasing short-term welfare.

38 Similar arguments can be found in J. P. Choi, B.-C. Kim, op. cit., for a monopoly network.

39 See G. S. Ford, T. M. Koutsky, L. J. Spiwak: Network Neutrality and Industry Structure, Phonix Center Policy Paper, No. 24, 2006.

40 B. E. Hermalin, M. L. Katz, op. cit.

41 J. Stennek, op. cit.

Table 1
The Aggregate Welfare Effects of Access-tiering, Decomposed into Static and Dynamic Welfare

		Effect of access-tiering on dynamic efficiency		
		(+)	(0)	(-)
		Scenario 1	Scenario 2	Scenario 3
Effect of access-tiering on static efficiency	(-)	Access-tiering is not problematic (overall effect: +)	Access-tiering is problematic (overall effect: - but small)	Access-tiering is strongly undesirable (overall effect: - and large)

incentives to invest than the socially optimal level.[42] When investments at both the networks and applications levels are brought about by the same vertically integrated firm, these externalities can be internalized leading to the social optimal level of investment and therefore increasing the incentives of network operators to invest.

Scenarios and the Level of Intervention

From the discussion above, we can generally conclude that access-tiering reduces static efficiency. We will now consider three scenarios according to whether the overall dynamic efficiency – in the applications and networks levels – gets higher (-) or lower (+) as a result of access-tiering, or the overall effect is negligible (0). In Table 1, we "calculate" overall welfare by aggregating static and dynamic efficiency under the assumption that dynamic efficiency gets a substantially larger weight than static efficiency.

From the table, the following conclusions may be drawn for policymakers. In scenario 1, policymakers need not worry about access-tiering, as the short-term negative effects are likely to be small compared to the long-term positive effect, and therefore they can use a "hands-off" policy. Nevertheless the regulator should remain alert that as a result of exclusive dealings, the reduction of variety and transparency should not become too problematic.

In scenario 2, the regulator may opt for using policy tools which spur the competition at the networks level (e.g. by stimulating facilities-based competition, or possibly mandating network unbundling). Then network operators have less long-term incentives to discriminate unduly without losing their market shares.

In scenario 3, policymakers should try to prevent access-tiering, as it substantially reduces welfare. Interventions may range from specific access-tiering regulation (e.g. requiring non-discriminating offers for a certain priority, interoperability or minimal quality of service[43]) to imposing network neutrality. As we have already mentioned, mandating network neutrality is likely to facilitate innovations at the edges, but it might decrease incentives to invest in and upgrade networks. At this stage, it is hard to assess whether the benefits outweighs the costs. Furthermore, the costs of such interventions (the cost of regulation and the risk of regulatory failure) have to be assessed before one can decide on the optimal type of intervention.

Conclusion

We have considered the discriminating practices known as port blocking or deliberate quality degradation, and access-tiering. If there is a lack of competition at the networks level and access is regulated, port blocking and quality degradation are typically bad for welfare and should be discouraged by antitrust policy. If facilities-based competition is sufficient, a network operator may back out of using blocking because of the potential loss in its market share. Nonetheless, if anticompetitive practices take place and the *ex post* intervention is not effective, for instance because such practices are difficult to detect, *ex ante* regulation may be desirable, say through technical requirements on network traffic. Further research is necessary to assess whether policymakers should worry about port blocking and quality degradation.

Access-tiering is more difficult to assess from a welfare perspective. First of all, it can be expected to soften competition between networks and to reduce variety and transparency for consumers, both of which are bad for static efficiency. In addition, it can increase network operators' bargaining power with regard to developers of applications and services. The resulting increase in market power may either improve or reduce the incentives of networks to invest and innovate. More important is probably whether or not it becomes

[42] See B. van Schewick, op. cit.; and J. Farrell, P. J. Weiser, op. cit.

[43] Those regulatory tools which require special standards to increase the universality and the openness of the internet so far have contributed to the dynamic growth of the internet including investments at both levels. Cf. T. Berners-Lee, op. cit.

more difficult for independent application providers to develop and implement innovations. Our paper suggests that *laissez-faire* might be risky because of the potential welfare loss. On the other hand, specific intervention may create a heavy burden on market players, and the risk of regulatory failure may be large. An intermediary type of solution could be to rely on interoperability requirements with minimal obligations, while application and service providers do not have to carry the burden of proof if things go wrong. This solution includes few regulatory costs, does not require additional information, and bears few risk of regulatory failure or distorting market incentives.

If there is sufficient competition between networks, then access-tiering, assuming it reduces dynamic efficiency, may be somewhat less harmful, as consumers can switch to other networks. With only two networks (e.g. DSL and cable), the effect of access-tiering may simply be that competition is softened while consumers have a harder time in matching their preferences to the portfolios offered by the networks. The larger the number of networks, the less this is likely to happen. The same can be said if, because of regulated access, there is a fringe of DSL entrants (other ISPs) that impose competitive discipline on the network operators, as is the case in many European countries. On the other hand, if alternative networks do not play a significant role and if there are no DSL entrants, so that effectively there is a very small number of network operators, then access-tiering may hurt both consumers and the developers of applications and services.

Can more intensive competition between networks mitigate the negative consequences of discriminative practices? One way to achieve more competition is through mandatory access to networks. Although mandated access may intensify service-based competition, thus increasing static efficiency, the regulator has to keep in mind that it may also lead to a lack of incentives to invest at the networks level, which decreases dynamic efficiency. Another way to intensify competition (endogenously) is as follows. In response to port blocking, quality degradation and access-tiering, applications and service providers may want to reduce their dependence on network operators by rolling out their own networks. If this happens, it is the market that finds a solution to practices that undermine network neutrality. As a result, facilities-based competition will become more intense, while the variety of services for consumers will remain intact. However, because of network duplication, static efficiency may be reduced. Overall, it is therefore uncertain whether such a market-based response is better for welfare than policy intervention.