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3.4 Why imposing new tolls on third-party content and applications threatens innovation and will not improve broadband providers' investment

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I Background

A The open Internet and innovation

The Internet is so deeply embedded in people's lives that it is all too easy to forget that its commercial life is approximately a mere fifteen years. The Internet's amazing and immediate benefits have been based on its openness, ubiquity, and non-discrimination. This non-discrimination – dubbed “network neutrality” – means that content from anyone and of any type is treated equally by broadband providers. Its open and public standards and the fact that no one has had to ask permission from network operators to innovate have resulted in rapid innovation that contributed to one of the greatest periods of economic growth in history, unprecedented access to information, and fostered amazing creative interactions.¹

The Internet's tremendous success has also been based on harnessing and benefiting from networks effects. The Internet exhibits network effects because each user's value from connecting to the Internet increases as more computers

and users are added to the network.² The value of a user's experience depends on and increases with the amount of content and applications available on the Internet. The value of content and applications on the Internet, in turn, increases with the number of users connected. This creates a virtuous cycle that dramatically expands the value of the network as its size grows. Because of these network effects, the value of the Internet to users and companies depends crucially on two factors: (i) the number of users that adopt (penetration); and (ii) the number of firms that create applications for the Internet or make content available on the Internet. In addition, in many economic environments, consumers and businesses benefit more from innovation and the resulting growth than from the static benefits of allocative and productive efficiency. With respect to the Internet, the spillover benefits in this regard are very significant.³ Dynamic efficiency requires creating conditions to promote the appropriate level of innovation leading to economic growth. The Internet's design allows businesses

¹ For example, Nina Czernich, Oliver Falck, Tobias Kretschmer, and Ludger Woessmann, (2009) “Broadband Infrastructure and Economic Growth,” CESifo Working Paper No. 2861, available at www.CESifo-group.org/wp, find that a 10 percentage-point increase in broadband penetration raises annual per-capita growth by 0.9-1.5 percentage points. Such increase in economic growth would add to U.S. GDP \$1.5 to \$2.5 trillion dollars in the ten-year period 2010-2020.

² See Nicholas Economides (1996), “The Economics of Networks,” *International Journal of Industrial Organization*, vol. 14, no. 2, pp. 675-699, at http://www.stern.nyu.edu/networks/Economides_Economics_of_Networks.pdf.

³ See Christiaan Hogendorn (2010), “Spillovers and Network Neutrality,” mimeo for a discussion of network and spillover effects on the Internet.

and consumers connecting to it (“at the edge” of the network) to innovate without obtaining approval from network operators. As a result, all innovation that is expected to yield benefits greater than its costs can occur; this is different than in a centrally controlled network where innovation at the edge would be restricted by the network operator based solely on whether the innovation brought profits to the network operator rather than whether the benefits of the innovation to the whole society exceeded its costs. This unleashes a huge potential for innovation.

B How content providers already pay for network transport

This paper is going to focus on one particular facet of the Internet’s current structure, which is the current way that content and application providers obtain network transport such that they are accessible by end-users. The fact that broadband providers only charge on one side of the market – to end-users – has helped protect the “innovation without permission” nature of the Internet and kept barriers to entry low.

While some broadband providers have called content and application providers free riders,⁴ this is incorrect and misguided. The Internet’s basic structure functions in the following way. Users at the “edge” of the network each pay for their own connections. That is, a residential end-user will pay a broadband ISP in order to access the Internet, and content providers will also pay an ISP in order to make their content available across the Internet. Each ISP will pay an Internet Backbone Provider (IBP) in order to send traffic across the Internet. The typical “transit” contract between an ISP and an

IBP provides an ISP a pipe of a certain bandwidth through which it can access the whole Internet. ISPs might also peer with other networks, in order to exchange data between them at no cost.⁵ Although the Internet is composed of a large number of interconnected networks, its market relationships are typically bilateral, specifically between an ISP and an IBP, between two IBPs, or between a business or residential customer and an ISP.

While users and content providers each pay their own ISPs for connectivity, neither need pay other ISPs in order to reach their customers. In order for me to communicate with my family members in California, I do not need to pay their ISPs; rather, I simply pay my own ISP in New York. The same is true of content providers – they pay an ISP for network transport, but they do not have to pay the ISPs of Internet users in order to reach those users.

In the market for last-mile services provided to end-users, there is significant concentration in the market as I discuss below and thus there are concerns about inefficient pricing there. However, across the rest of the Internet, the collection of bilateral market relationships for network transport works relatively efficiently today. What an ISP pays to a backbone is a function of the value that it brings to the Internet and is determined through negotiations between the ISP and the backbone. Since there are many IBPs with which an ISP can connect, the ISP can negotiate a price with them that reflects its value to them. Similarly, the resulting price is a function of the value that the IBP brings to this ISP. That is, the resulting price that an ISP pays to IBPs is market-determined through negotiations between them. Likewise, pricing for connection to the Internet by content and applica-

4 See, for example, the interview of Ed Whitacre, AT&T’s ex-CEO in BusinessWeek referring to the use by Google, MSN, Vonage, and others of AT&T’s Internet infrastructure: “Now what they would like to do is use my pipes free, but I ain’t going to let them do that because we have spent this capital and we have to have a return on it.” BusinessWeek November 7, 2005.

5 Under peering, two interconnecting networks agree not pay each other for carrying the traffic exchanged between them as long as the traffic originates and terminates in the two networks. For a more detailed discussion, see Nicholas Economides (2007), “The Economics of the Internet,” *The New Palgrave Dictionary of Economics*, London: Macmillan, 2007, at http://www.stern.nyu.edu/networks/Economides_Economics_of_the_Internet_for_Palgrave.pdf, at p. 4.

tions providers is determined through negotiations with ISPs. For example, suppose that Comcast as a local ISP can bring very valuable customers from area X to the Internet. It can and does negotiate its connection price with multiple IBPs, and the resulting price(s) reflects the value that Comcast's customers bring to the Internet. Suppose that also connected to one of these IBPs is Yahoo's ISP which sends and receives information packets from Comcast's customers. Yahoo's ISP also negotiates a price with this and other IBPs for transport service reflecting the value it brings to the Internet. Throughout this series of market transactions, from ISP to IBP, from IBP to ISP, and from ISP to content or application provider, market prices are determined. Because these prices are all market-determined and because there is significant competition among IBPs, they have worked well in aligning payments with value provided. The market between ISPs and IBPs has been unregulated throughout the commercial life of the Internet and there is general consensus that it has worked well so far.⁶ These current pricing arrangements are a feature, not a bug, of the Internet as we know it today. As I will explain below, deviating from the status quo could have grave consequences.

II The dangers of broadband providers erecting new tolls on the Internet

Broadband providers have the ability to charge content and applications providers to allow them to reach end-users ("termination fees"). They could also engage in paid prioritization arrangements – that is, they could offer to prioritize a providers'

traffic so that it reaches end-users with a guaranteed higher *relative* quality (that is, faster relative speed or lower relative latency). Providers who pay a surcharge would receive this prioritized treatment, while others' traffic would only be delivered on a best-efforts basis.⁷ These arrangements threaten innovation online and social welfare for a number of reasons. For the purposes of this paper, I do not consider separately broadband provider's prioritizing traffic without charge to third-parties, although many of the concerns I raise below would be equally applicable. I will show below that last mile residential broadband providers have incentives to use discrimination to the detriment of the societal value of the Internet.

A Pricing will not take into account network effects and the full benefits of innovation, creating inefficiency

The existence of network effects and other spillovers means that the market will under-supply innovation in content and applications, relative to the socially optimal level. Because broadband providers do not internalize the value from network effects or other spillovers to consumers and society in general, their pricing decisions when charging content and application providers do not take its full societal impact into account.⁸ As such, we can expect these prices to be above the socially optimal level. This, in turn, would reduce the value to users and would diminish adoption and the virtuous cycle of network effects and spillovers.⁹ Further, the market might also underprovision Internet content because it exhibits the characteristics of a public good, in that it can be consumed by one person

6 See Nicholas Economides (2005), "The Economics of the Internet Backbone," in Ingo Vogelsang (ed.) *Handbook of Telecommunications*. Amsterdam: Elsevier Publishers, 2005, at [http://www.stern.nyu.edu/networks/Economides ECONOMICS OF THE INTERNET BACKBON E.pdf](http://www.stern.nyu.edu/networks/Economides%20ECONOMICS%20OF%20THE%20INTERNET%20BACKBON%20E.pdf).

7 Higher relative speed does not imply higher absolute speed since it can be achieved by slowing down other packets rather than speeding up the prioritized ones.

8 See Hogendorn (2010), footnote 3.

9 Additionally, many of the goods consumed on the Internet are information goods and therefore are public goods. Such goods can be consumed without being diminished and their contribution to consumer's surplus may be significantly higher.

without diminishing its value to anyone else and it may be hard or difficult to exclude people from using the good. If we cannot subsidize innovation, a network access price close to cost to the content and applications side is the second best. Content and application providers already pay for network transport at a cost that can be assumed to be near the incremental cost, since that price is set in a relatively well-functioning market. Levying additional fees on these providers would mean that they would be paying significantly above the cost of network transport, which would reduce the amount and variety of content and applications produced, as well as innovation at the edge of the network and network effects.

Some economists have modeled the proposed imposition of fees by broadband providers to content and applications providers on the other side of the market in a concentrated market. In making this assessment, it is crucial to take into consideration at least four benefits to society from changes in pricing on the Internet: (i) the direct consumers' surplus (difference between what consumers are willing to pay and what they actually pay); (ii) the profits of the networks; (iii) the profits of the content and applications companies that distribute or provide services through the Internet; and (iv) the benefits of innovation at the edge of the network. Economides and Tag¹⁰ (2009) calculate the effects of broadband providers imposing fees on content and applications providers. Without considering the effects on innovation, they find that introduction of such fees reduces total surplus (the sum of (i), (ii) and (iii) above). Since such fees would also reduce innova-

tion at the edge of the network, the results of this paper show that they will significantly reduce societal benefits from the Internet. Yet a monopolist or duopolist broadband provider has an incentive to introduce such fees if left unfettered.

B Termination fees and paid prioritization undermine the current efficient market for network transport and introduce new transaction costs

When supporting imposition of these fees, it is truly ironic that some broadband providers claim to be promoters of markets. In fact, new tolls would allow broadband providers to bypass a well-functioning market and impose arbitrary contracts. These sorts of fees would circumvent the existing Internet transport market and negate the efficiency all agree it provides.

These fees threaten to increase dramatically transaction costs for creators of content on the Internet. As Lee and Wu¹¹ (2009) and Bauer¹² (2007), among others, argue, it is important to recognize that there is a big difference between zero fees and small fees. By having zero fees, one eliminates a great range of costs for content providers, since they need not inform themselves about how to reach end users, they need not contact and bargain with last-mile access providers and they need not pay any additional fees. Introduction of new transaction costs can be particularly harmful for small businesses, for startups and for individual content providers maintaining blogs – the type of agents that have contributed so much to the explosion in content and innovation on the Internet during the last decade.¹³

¹⁰ Nicholas Economides and Joacim Tag (2009), "Net Neutrality on the Internet: A Two-sided Market Analysis," NET Institute Working Paper.

¹¹ Robin Lee and Timothy Wu (2009), "Subsidizing Creativity through Network Design: Zero-Pricing and Net Neutrality," *Journal of Economic Perspectives*, vol. 23, no 3, pp. 61–76.

¹² Johannes Bauer (2007), "Dynamic Effects of Net Neutrality," *International Journal of Communication*, vol. 1, pp. 531-547.

¹³ The effects of such fees are accentuated by the fact that content is an "experience good" which means that its value and features are hard to ascertain before consumption. Imposing fees will make it more likely that it will be much harder for new content firms to reach consumers and to survive.

Further, if these fees are imposed, we will potentially see an exponential growth in demands by broadband providers to collect money from a large number of ISPs and from the much larger number of the ISPs' individual customers. Instead of the straightforward voluntary market transactions that we observe today, which developed over time and without regulatory intervention, we may see an explosion of attempts by broadband providers with market power to collect money from any one of a very large number of hosts on the Internet.

The explosion in pricing may also result in substantial and needless confusion, which would make providing content on the Internet much harder, would limit incentives to innovate, and reduce benefits of network effects. In fact, the resulting confusion and disarray may lead to calls for new rate regulation in this arena, which may be far more intrusive than what the FCC has currently proposed. There is a long history of regulating termination fees in the context of the telephone industry.

C Broadband providers' are vertically integrated entities. Broadband providers have unique incentive to disadvantage competing application and content providers, and third-party charges inherently will favor broadband providers' affiliated services.

Since the last-mile broadband providers also operate in the content and applications markets, there is no way for a single price/fee to all content providers, affiliated and unaffiliated, to be "non-discriminatory" in an economic sense. Charges to the affiliated content division are merely accounting entries for the last-mile provider, and do not reflect a real additional cost to the company as a

whole. In contrast, the price impacts the unaffiliated provider's decision making much differently as it must actually pay the price or fee. For example, if the last-mile provider sets a price well above incremental cost, it will still base its decisions on the incremental cost (regardless of the internal transfer price) while an unaffiliated provider will base its decision on the price quoted by the broadband provider.

Moreover, broadband providers have the incentive to deliberately give their own services favored treatment and withhold that from competitors. Internet provision is not the main business of broadband providers serving residential customers. The main business of telecommunications carriers is phone service; the main business of cable television companies is providing cable television service. Both types of companies provide Internet service, but it is neither their primary service nor their main revenue line. Thus, it is natural for these companies to have conflicts between their traditional services and substitutes to them that are provided over the Internet. Voice over Internet Protocol (VoIP) is produced over the Internet but competes with traditional telephone service. VoIP of an independent provider, such as Vonage, competes with branded VoIP of a cable company. In both cases, the incentives to discriminate against the rival's service both in price and in a non-price manner are obvious.¹⁴ There are similar concerns with cable television and video services provided by telecommunications companies. There is an emerging market for video downloads over the Internet that directly competes with the incumbents' broadcast channels over cable.

Although active sabotage of a competitor's service is obviously an illegal form of discrimination, broadband providers do not need to use this tactic. For example, to discriminate effectively

¹⁴ For a more detailed analysis, see Nicholas Economides (1998), "The Incentive for Non-Price Discrimination by an Input Monopolist," *International Journal of Industrial Organization* 16, no. 3, pp. 271–84, http://www.stern.nyu.edu/networks/The_Incentive_for_Non-Price_Discrimination.pdf.

against a VoIP competitor, it would be sufficient for the access provider to set a high fee for access to the “premium lane,” which will effectively block profitable operation by the competitor whose operation is relegated to the “standard lane” the speed of which has been degraded by allocation of bandwidth to the fast lane. We should guard against the possibility that “network management” may be used to discriminate against rivals’ services. This underlines the necessity for transparency in network management.

D Termination fees and paid prioritization will tilt the competitive playing field, raising barriers for new entrants

If broadband providers are able to engage in paid prioritization schemes, the “winner” in the market would be the application or content providers that are able to afford to pay for prioritization. In markets with network effects, there can be “lock-in,”¹⁵ that is, a firm with significant market share can preserve its dominance for a long time, with adverse consequences to innovation. Lock-in is more likely when the costs of entry are high. Here, discrimination by the broadband providers would increase the costs of entry of innovators and make it more likely that (i) less innovation would occur; and (ii) the “winner” chosen by the broadband providers would remain in place for the long term.

Moreover, there are technology-specific investments that networks may make that will perpetuate an old winner regardless of its current advantages. For example, *Real* was the first commercial entity to create a compression technology that allowed for streaming audio and video in the dial-up world. *Real* was the market leader even in the infancy of the broadband transition. If broadband providers had selected

Real as the prioritized media player at that time, they would have optimized their networks for that service. Other technology would also have been customized to *Real*, and, as a result, investment in developing better compression technologies and alternative video systems, such as Bit Torrent and YouTube, may not have been developed.¹⁶

Furthermore, once successful innovations have occurred at the edge of the network, a network operator with market power has an incentive to exercise its control of the network to raise its access price to innovators who have succeeded. This significantly dampens the *ex ante* incentives for such innovations to occur. Network neutrality preserves the innovation incentives at the edge of the network and prevents *ex post* opportunism by network operators.

In the extreme, a broadband provider can use identity-based discrimination (based on source or ownership of content) and exclusive contracts to identify a “winner” on the content side and then charge them for the privilege. For example, an access network may offer the following contract to search providers. Only one search provider will receive prioritization, and all other search providers must use the slow lane. If relative speeds matter to customers, it can make the prioritized search provider’s service more valuable and more widely chosen than its rivals’ service even if that was not the case before the introduction of the price discrimination scheme. Essentially, this price discrimination scheme picks the winner in search in exchange for the price of the exclusive prioritization.

This contract would create a number of distortions in the market for search, including: (1) the winner will be the one with the deepest pockets and not necessarily the one that is best in search;

¹⁵ See Joseph Farrell and Garth Saloner (1985), “Standardization, Compatibility, and Innovation,” *Rand Journal of Economics*, vol. 16, pp. 70-83.

¹⁶ See M. Chris Riley and Robb Topolski (2009), *The Hidden Harms of Application Bias*, mimeo, pages 6-7.

(2) it distorts the innovation race – new companies without deep pockets are eliminated from the competition; (3) it raises the cost of innovation and diminishes innovation overall; (4) in the presence of network effects and lock-in it can result in these suboptimal choices persisting in the long run. This price discrimination scheme can lead to a suboptimal choice in any year it is in effect. In the presence of network effects and lock-in, even if the choice were optimal in the year it was made, that choice can be locked-in and persist in the long run. For example, if such a scheme was in effect in 2000, it would have chosen Microsoft or Yahoo as winners in search and due to lock-in Google might never have succeeded.

E Termination fees and paid prioritization threaten to create a “prisoner’s dilemma” where consumers as well as application and content providers are all worse off

Suppose that a broadband provider offers prioritization guaranteeing that, for example, video content providers¹⁷ in the priority lane arrives a few seconds before all other providers in the standard lane. This can be done just by slowing the standard lane down by a few seconds without making any data move faster. Given the prospect of losing almost all their customers if they stay in the slow lane, every video content provider that can afford it will choose to pay to be in the “priority lane.” What is the result? The video content of the remaining active firms would all arrive at the same speed as before, competition would remain the same among the firms that can afford the payment, but all these firms would pay a higher price to broadband providers. The companies that cannot afford to pay die. Both surviving and foreclosed firms are worse off. Consumers are worse off as they now have fewer choices on the con-

tent and applications side of the market. Allocative efficiency is reduced since content providers now pay additional fees over and above the cost-based fees that they already pay for connection to the Internet.

In this scenario, the broadband provider, in the absence of limits on discrimination towards content and applications providers, has forced content providers to play a prisoners’ dilemma game and they all lose as a result. Society loses in terms of innovation that will not occur because only firms with deep pockets can survive; in terms of the reduced variety of services due to the foreclosed firms that have disappeared; and in terms of consumers’ surplus lost because of the disappearance of some content providers. Moreover, this price discrimination scheme can be forced by the broadband providers on each subsector of content and applications providers, multiplying the adverse effects on competition, innovation, and availability of varieties in every area of content and applications.

The consequences of such fees can be even worse for society when discrimination is more extreme. For example, the broadband provider can offer prioritization that guarantees the video content in the priority lane arrives ten seconds before video content in the standard lane, but this time only provides prioritization to a single video content provider. This will guarantee that other providers are foreclosed from this access network. Such a price discrimination scheme makes the prisoners’ dilemma even more extreme. Each video content provider will try as hard as possible (and will offer very large sums of money) to be the one picked for the priority lane. Moreover, broadband providers will have an incentive to write such contracts as the willingness to pay of the winning content provider increases when it faces less competition.

¹⁷ One could of course offer a similar example using search information, VoIP, interactive gaming, and so on.

F Paid prioritization schemes would create perverse incentives to degrade service quality or avoid network upgrades

For competing content services, the *relative* speed of information arrival is often crucial to users regardless of absolute speed. In these cases, content providers are willing to pay more for a faster relative speed to ensure an advantage on the competition. If unrestrained, the broadband provider has an incentive to create artificial congestion in the “slow lane” that will make consumers value more the prioritized information packets (in the “fast lane”) and value less the ones that did not pay for prioritized service (in the “slow lane”). This is not predicated on the existence of congestion *before* the introduction of the prioritization scheme. Even without any *ex ante* congestion, a broadband provider with market power has incentives to create congestion in the “slow lane” and artificially create a speed difference in the arrival of prioritized and non-prioritized packets. Therefore instead of solving a congestion problem, the introduction of prioritization is likely to create one, resulting in allocative inefficiency.

The fact that businesses may intentionally take costly measures to degrade the value of a product in order to implement price discrimination is well

understood in the economics literature. See for example, Deneckere and McAfee¹⁸ (1996), who develop this theory in detail.¹⁹ The basic understanding dates back at least to the early nineteenth century in France (see Jules Dupuit (1844)).²⁰ In the telecommunications industry itself, telephone companies were originally reluctant to promote DSL because it cannibalized existing, lucrative high-end T1 services.

Choi and Kim²¹ (2008), Lee and Wu (2009), and Peha²² (2007), discuss the introduction of price discrimination toward content providers and note that prioritization *reduces* their incentive to invest in network capacity. Content and application providers will only be willing to pay for prioritization if there is a meaningful difference between the “fast” and “slow” lanes. Thus, broadband providers would have an incentive to avoid investing in capacity and solving congestion problems. I will discuss this in detail in the network investment section.

G The lack of competition in the last-mile dramatically heightens these worries

These potential harms are particularly worrisome in light of the fact that residential users have limited choices of broadband networks. The lack of competition concentrates market power for the

18 Raymond J. Deneckere & R. Preston McAfee (1996), “Damaged Goods,” *Journal of Economics & Management Strategy*, vol. 5, no. 2, pp. 149-174.

19 Also see: Michael Mussa, and Sherwin Rosen (1978), “Monopoly and Product Quality,” *Journal of Economic Theory*, vol. 18, pp. 301 – 317; Eric Maskin, and John Riley (1984), “Monopoly with Incomplete Information,” *RAND Journal of Economics*, vol. 15, pp. 171 – 196; Jean Tirole (1988), *The Theory of Industrial Organization*, The MIT Press, Cambridge, MA, pp. 149 – 150; and Hal R. Varian, “Price Discrimination and Social Welfare,” (1985), *American Economic Review*, vol. 75, no. 4, pp. 870-875, and the references therein.

20 Arsène Jules Étienne Juvénal Dupuit (1844), “De la mesure de l’utilité des travaux publics,” *Annales des ponts et chaussées*, Second series, 8. Translated by R.H. Barback as “On the measurement of the utility of public works,” *International Economic Papers* (1952) vol. 2, pp. 83-110. Reprinted in: Kenneth J. Arrow and Tibor Scitovsky, eds., *Readings in welfare economics* (Richard D. Irwin, Homewood, IL, 1969), pp. 255-283., wrote about implementation of price discrimination in French railways: “It is not because of the few thousand francs which would have to be spent to put a roof over the third-class carriages or to upholster the third-class seats that some company or other has open carriages with wooden benches. What the company is trying to do is to prevent the passengers who can pay the second class fare from traveling third class; it hits the poor, not because it wants to hurt them, but to frighten the rich. And it is again for the same reason that the companies, having proved almost cruel to the third-class passengers and mean to the second-class ones, become lavish in dealing with first-class passengers. Having refused the poor what is necessary, they give the rich what is superfluous.”

21 Jay Pil Choi and Byung-Cheol Kim (2008), “Net Neutrality and Investment Incentives,” NET Institute Working Paper.

residential access broadband networks. In turn, market forces are inapt to check harmful behavior by broadband providers, as consumers cannot easily and without facing costs switch to other providers. As I explain below, market power of last mile access broadband networks arises not only from the small number of available choices at a consumer's location but also because of the existence of significant switching costs, competition-lowering effects of bundling Internet service with other services, and new uncertainty and information costs to consumers should discrimination be introduced.

Most U.S. households face a choice of at most two competing broadband providers and broadband pricing is determined by a duopoly between a cable and a phone company.²³ Several sources confirm this. Turner²⁴ (2009b) estimates that to-

gether incumbent phone and cable companies control 95% of the broadband market considering all available technologies. A report by the Congressional Research Service describes the broadband market as a "duopoly for the foreseeable future."²⁵ GAO²⁶ (2006) finds that all but two percent of broadband users subscribe to either DSL or cable modem access. Pew²⁷ (2009) finds that on average households face a choice of only 2.5 providers, including resellers.²⁸ Due to the limitations of satellite and mobile technologies, DSL and cable modem access still represent the vast majority of broadband connections. Widely deployed, third-generation, high-speed mobile Internet services are still not frequently adopted because high prices and their slower speeds relative to fixed broadband services limit their usefulness as a substitute for wireline service.²⁹ Satellite ac-

22 Jon Peha (2007), "The Benefits and Risks of Mandating Network Neutrality, and the Quest for a Balanced Policy," *International Journal of Communication*.

23 An economic method for summarizing the degree of competition between duopolists is the elasticity of firm-specific demand. This measures the percentage decrease in the firm's sales when it increases its price unilaterally by one percent. If the market were highly competitive, such a unilateral price increase would result in a huge drop in sales (in a fully competitive market the firm increasing its price would lose all its sales and the elasticity would be negative infinity). Studies of the firm-specific price elasticities of demand for cable modem and DSL service in the U.S. place them between -0.59 and -1.465. P. Rapoport, D. Kridel, L. Taylor, J. Alleman, and K. Duffy-Deno (2003), "Residential Demand for Access to the Internet," in G. Madden ed., *Emerging Telecommunications Networks: The International Handbook of Telecommunications Economics Vol. 1*, Cheltenham: Edward Elgar, pp. 55-72, estimate the price elasticity of demand for cable modem access as -0.59 for DSL access as -1.465. Robert Crandall, Gregory Sidak, and Hal Singer (2002), "The Empirical Case Against Asymmetric Regulation of Broadband Internet Access," *Berkeley Technology Law Journal*, vol. 17, pp. 953-987, estimate the price elasticity of demand for cable modem access as -1.22 and for DSL access as -1.18. That is, a broadband provider can raise price by one percent (while the rival keeps its price fixed) and its sales will drop by 0.59 to 1.465 percent. Since broadband providers face a relatively inelastic firm-specific demand, they have significant market power.

24 Derek Turner (2009b), *Dismantling Digital Regulation: Toward a National Broadband Strategy*, available at http://www.freepress.net/files/Dismantling_Digital_Deregulation.pdf.

25 Congressional Research Service (2006), *Access to Broadband Networks*, available at http://www.ipmall.info/hosted_resources/crs/RL33496_060629.pdf, page 17.

26 GAO (2006), *Broadband Deployment is Extensive throughout the United States but it is Difficult to Assess the Extent of Deployment Gaps in Rural Areas*, available at <http://www.gao.gov/new.items/do6426.pdf>.

27 Pew Internet & American Life Project (2009), *Home Broadband Adoption 2009*, available at <http://pewinternet.org/Reports/2009/10-Home-Broadband-Adoption-2009.aspx>.

28 Computations based on data from pages 23 and 24 of Pew (2009) excluding respondents who "don't know" and assuming four providers for those who face four or more providers. 23% of households have the choice of only one provider, 24% two providers, 33% three providers, and 20% four or more providers.

29 See Turner (2009b).

cess also suffers from high prices and slow speeds as well but also is hampered by high latency which limits its use primarily to areas with no other available options.³⁰

The wireless market – which at present provides only a complement and not a substitute for wireline broadband service – is also highly concentrated. Four carriers control over 90% of the market, with Verizon and AT&T, two of the incumbent telephone companies, comprising over 60%.³¹ Turner (2009b) estimates that incumbent telephone companies control over 80% of the high-speed mobile Internet access market.

The market power of access networks is enhanced by (i) the existence of switching costs; (ii) bundling of broadband Internet with other services; and (iii) information costs and uncertainty to consumers should discrimination be introduced. Residential customers contemplating changing broadband providers have to change the equipment they use at home and the physical network access at their location. These switching costs are significant and create market frictions that contribute to the ability of networks to keep customers. Since customers will not respond by changing providers to a lower price from a rival, broadband providers face a less elastic firm-specific demand and have stronger incentives not to cut prices, leading to market power and higher equilibrium prices of residential broadband Internet access.

In addition, the best pricing for residential broadband Internet access is often available only when the customer buys a bundle of services from the same provider. For example, a cable television company may provide a lower price

for broadband Internet access if the customer also subscribes to its television service. This creates an additional impediment for residential users who are contemplating changing broadband providers. If a customer does so, his remaining services with the old provider may become more expensive. As a result, a customer will not change Internet service providers even if a rival offers cheaper broadband service unless the rival also offers the bundled service and the customer likes it equally well³². Thus, bundling of Internet service lowers the firm-specific elasticity of demand and adds to the market power of last mile access networks.

Moreover, if discrimination toward the content side of the market is introduced, consumers will generally not know why some information and services come to them with delay or not at all. New providers may never reach consumers, and consumers will never know what they missed. Delays in services of known providers may be attributed to them rather than to the network. Thus, discrimination can create significant uncertainty and information costs to consumers. The fact that the quality of the network services is opaque to consumers under discrimination, confers additional market power to access networks.

Consistent with economic theory and these findings, the result of the broadband providers' market power is lower penetration and higher prices for broadband service in the U.S. relative to comparable countries. An OECD study and other sources report low broadband Internet penetration in the U.S. and a deteriorating U.S. penetration international ranking. The OECD reports that the United States is ranked fifteenth in market penetration (broadband connections per 100 in-

³⁰ See GAO (2006), page 8.

³¹ See Josh Koshman, *New sell needed for cellphone companies*, New York Post (Dec. 27, 2009) available at http://www.nypost.com/p/news/business/new_sell_needed_for_cellphone_companies_QUyAmcswYWheqK63oRX2L

³² For example, telephone companies typically do not provide the assortment of television channels offered by cable television companies making it costly for a household to switch from cable modem to DSL service if he/she also values television services.

habitants) among OECD members.³³ The United States ranks below a number of European countries as well as Korea and Canada. Additionally, the difference between the United States and leading countries is substantial. The top five countries in broadband penetration have on average 24% higher penetration than the United States, and the top ten countries have on average 20% higher penetration than the United States. The United States would have to increase its broadband penetration by 20% to reach the average of the top 10 countries, and by 24% to reach the average of the top five. “Table 3.1 shows broadband penetration per 100 inhabitants in OECD countries and Figure 3.1 depicts this information. The broadband penetration ranking of the U.S. has deteriorated from third in 2001 to twelfth in 2005 to fifteenth in 2006-2008. Table 3.2 lists US rankings from 2001-2009, and Figure 3.2 depicts this information.”

It is important to note here that since the last-mile access networks to residential users are serially-related to (that is, not substitutable with) the Internet backbone, competitive forces in the backbone cannot eliminate the market power and resulting market distortions in the last-mile access networks to residential consumers. Therefore, market power in the last-mile is not eliminated and affects the whole Internet.

H Multi-sidedness on the Internet does not imply positive charges on all sides

As a communications network, the Internet consists of over a billion devices (nodes) connected through links and routers. In many ways, it is a

billion-sided network. Any user has the possibility of setting up content and engaging in a variety of downloads or transmissions such as email, video, pictures, and postings. By grouping users according to their most common activity on the network, one can attempt to reduce the number of “sides” of the network. So, residential users can be thought of as net consumers of information while search engine companies can be thought of as net producers of refined or structured information. In this way, some describe the Internet as two-sided. However, if the object of interest were news commentary, there is no easy division between the producers and consumers. Many nodes are both consumers and producers. This is in sharp contrast with other two-sided networks where the roles are strictly defined. For example, payment systems networks, such as the card networks of MasterCard, Visa and American Express function as two-sided networks. One side of the market (card holders) is quite distinct from the other (merchants). On the Internet, the blurring of the identification with a specific side of the network cautions against using received wisdom from two-sided networks and blindly applying it to the Internet.

Even if the Internet is viewed as a two-sided network, there is no immediate implication that a broadband provider should charge both sides of the market. For example, in payment systems, American Express has no-fee cards that give 2% back to users on purchases while American Express collects a 3% fee from merchants. Even though it is able to charge both sides of the market, American Express, chooses to charge one side

³³ See OECD broadband web site at http://www.oecd.org/document/54/0,3343,en_2649_34225_38690102_1_1_1_1,00.html. Additionally, Turner (2009b) contains International Telecommunications Union (ITU) data showing US’s international ranking dropping from fifth in 2000 to twenty second in 2007. The low penetration ranking of the U.S. is corroborated by other studies. For example, using data on OECD countries from several sources and employing multiple metrics, a study by the Berkman Center for Internet & Society (*Next Generation Connectivity: A Review of Broadband Internet Transitions and Policy around the World*, available at [http://www.fcc.gov/stage/pdf/Berkman Center Broadband Study 13Oct09.pdf](http://www.fcc.gov/stage/pdf/Berkman%20Center%20Broadband%20Study%2013Oct09.pdf)) finds that among thirty OECD countries, the U.S. is in the third quintile of fixed broadband penetration and third quintile in average prices for all but the slowest broadband speeds.

and subsidize the other. Thus, the *private* incentives in some two-sided networks do not necessarily imply positive charges on both sides of the market.³⁴

III The danger of new tolls far outweighs the potential upside

I have thus far considered the possible harms of broadband providers deviating from the *status quo* by introducing new tolls on the Internet. That is not the only relevant factor in considering these new tolls, of course. In order to account fully for whether such a deviation would be socially beneficial, we must also consider the supposed benefits.

Broadband providers typically suggest two particular benefits. First, they argue that prioritization will be good for end-users, allowing the development of innovative new services. Many of the concerns I raise above can also be applied to prioritization generally, regardless of whether it is provided for a fee; for example, if prioritization is used to essentially “pick winners” in the market, that will impede innovation online, even if there is no charge to content or application providers. Within the scope of this paper, a critical point is that we must disentangle two different issues here – the technical merits of prioritization and its benefits to users, versus the merits of *charging third-parties* for prioritization. As I have argued above, the introduction of new tolls on the Internet – and a shift away from last-mile broadband providers simply charging their end-user customers – introduces particular concerns.

Broadband providers also argue that if they are not allowed to charge direct fees as well as to discriminate towards the content side of the market, they will invest less in their networks. They argue that under network neutrality they do not have sufficient funds to invest in the network. Sometimes this argument is augmented by assuming congestion in the local access network. However, I

conclude that the imposition of new tolls by broadband providers is unlikely to result in higher network investment and may even decrease investment for the following reasons identified in academic economic research.

IV If additional investment in capacity by a broadband provider is necessary, there is no need for special or additional fees charged to content and application providers

Here, too, we must disentangle two separate issues – whether additional investment is beneficial, and whether it must be paid for through content and application providers.

Broadband providers can of course charge users. Also, as discussed above, the present transit market works well. If a particular broadband provider believes that it deserves more revenue because it has customers that bring great value to the Internet, it can negotiate lower transit rates with backbone providers, effectively decreasing its operational costs. If in fact an ISP brings great value and this is recognized by the backbone providers offering lower prices, they, in turn, can adjust fees to all other ISPs, including those whom the content and applications providers use to connect to the Internet. In making these decisions, all parties have the appropriate incentives to evaluate the value added by each participant.

Thus, a market already exists which can appropriately and effectively respond to any special value that broadband providers bring to the Internet. Additional or special fees are unnecessary to align properly benefits with returns. In fact, the imposition of fees by a broadband provider to content and applications is an attempt to bypass the existing and well-functioning market for transport.

³⁴ See also the discussion on the divergence of private and public incentives in section II.A

A Higher revenue to broadband providers as a result of the imposing charges to content and application providers may not increase investment in the network

If limits on discrimination by broadband providers are abolished, it is unclear that the additional profits the broadband providers would earn from content and application providers would be used to finance investments in the network. The networks are profit-maximizing firms, and may simply pass on the additional profits to shareholders.³⁵ Since the broadband providers have significant market power, additional profits from violations of network neutrality are rewards of their monopoly power and not rewards for new investment or higher quality. Compared to perfectly competitive firms, networks with market power generally have incentives to invest less and sell less output. Additional profits from exercising market power will tend to benefit shareholders rather than being devoted to expanding output. Further, if upgrading the network was essential for future profitability, the last-mile networks have ample access to credit markets to fund the investments.

B In fact, paid prioritization may create incentives to reduce network investments

As discussed above, if broadband providers are allowed to charge content providers for prioritized access, they will have incentives to *reduce* investments in their networks. The more congested the network, the greater value prioritized access provides. This allows the broadband providers to charge content providers higher prices for priority access and make higher profits. Without congestion, broadband providers would be unable to charge higher prices for the priority service. Thus, allowing broadband providers to charge content providers for prioritized access creates an incentive to invest *less* in capacity and distorts incen-

tives to upgrade the network (see Choi and Kim (2008), Peha (2007), and Lee and Wu (2009)). There is a large theoretical and empirical literature that describes the incentives of a monopolist to degrade low-end products to make sure consumers buy more expensive, high-end products.³⁶ As monopolists, broadband providers have these same incentives and may want to create differentiation between their high- and low-end services by degrading the speed of their low-end service. This may result in maintaining congestion by not investing in new capacity or even artificially introducing congestion by slowing down the low-end service even when sufficient capacity is available.

C Paid prioritization misaligns the incentives to invest in the network.

Suppose there is a need for additional investment because of demand for priority delivery by some users. Some users may be willing to pay more to receive content faster (say by “streaming” a movie) while other users prefer downloading slowly (say by using buffer storage) and paying less. Economic theory says that in order to align properly market incentives those consumers who demand prioritization should pay and those who do not should not pay. This is easily and directly accomplished by broadband providers charging different prices to different end users based on their desired speed of service. On the other hand, imposing fees on content and application providers would require each of them to determine which customers desire a higher speed of service and which do not, imposing a significant burden on these providers given that they are much less informed about users’ desires than users themselves. Additionally imposing fees on these providers for *all* its transmissions irrespective of the distribution of its customers in terms of desire for speed will seriously misalign the market incentives.

³⁵ See Lee and Wu, 2009, among others.

³⁶ Also see cites in section II.F.

D Empirical evidence suggests that broadband providers invest more under network neutrality and also tend to invest more when regulations promote competition

There is evidence that broadband providers have invested large sums in upgrading their networks under the current regime in which they do not charge content and application providers. For example, Turner³⁷ (2009a) shows that AT&T's overall gross investments in its network increased by \$1.8 billion from 2007 to 2008 when it had consented to operate a neutral network under conditions imposed by the FCC in its acquisition of Bell-South. As a percentage of wire line revenues, wire line investments grew from 13.5% to 20.2%. Moreover, Turner (2009a) shows that capital investment in telecommunications was greatest during the regulatory period under the 1996 Telecom Act and then fell after the dismantling of the Act, suggesting that networks may invest more when regulation leads to increased competition.

E Discrimination diverts money away from network investment

Charging differential prices to content providers for access to consumers is costly for the broadband providers as they must carefully monitor and account for the traffic over their network. This would divert resources away from investments in network upgrades and toward systems necessary to implement price discrimination (see Peha, 2007).

F Setting aside all of the above and assuming additional charges did increase network investment, the charges could still result in a net social welfare decrease

Network investment is one of a number of variables that economists consider in deriving con-

sumers' welfare, firm profits, and total societal welfare. Identical levels of network investment can result in different levels of consumers' welfare and firm profits depending on prices and participation levels of users and content providers. The two-sided nature of the Internet implies that society can benefit from maximizing network effects (positive feedback effects) that flow from content providers to users and vice versa. Network investment can facilitate this interaction and create a virtuous cycle in which both sides reap the benefit of network effects as long as prices remain close to costs and are non-discriminatory. However, network investment combined with fees and price discrimination on the provider side and prices well above costs on the user side will reduce investment in and provision of content and applications as well as the penetration and use of the Internet, thereby significantly reducing the network effects that drive the Internet as well as the societal benefit from the Internet. Maximizing overall societal welfare should be the goal of policy, and it should not be sacrificed simply to find extra revenue for additional network investment.

V Conclusion

The FCC's proposed codification of the tradition of non-discrimination towards content providers on the Internet will be highly beneficial. The tremendous success of the Internet and its very significant contribution to economic growth has come in part from harnessing network effects. Network effects arise as more content and applications make a user's connection more valuable and vice versa. The ability to create and easily disseminate content on the Internet has been supported by its tradition of non-discrimination. The success of the Internet and the abundance of net-

³⁷ Derek Turner (2009a), Finding the Bottom Line: The Truth about Network Neutrality and Investment, Free Press, www.freepress.net.

work effects it harnesses are based the ability of individuals and companies at the edge of the network to innovate without asking permission from network operators.

The imposition of new charges on application and content providers by broadband providers would diminish the incentive to innovate, reduce the amount of innovation, reduce the amount of content and applications available, and make access to some content difficult. All these effects will individually and in combination reduce the societal benefits from the Internet.

In evaluating policy on the Internet, our goal should be maximization of societal benefits, which to a significant extent accrue from network effects. While investment in network infrastructure is desirable, it should not be the sole goal of policy. Policy that encourages network infrastructure investment but discourages innovation and the creation of network effects is undesirable. Additionally, I present a number of arguments that show that introducing discrimination is not necessary for expanding network investment, and under some conditions will reduce it.

Table 3.1.

Rank	Country	Internet Penetration
1	Netherlands	38.1
2	Denmark	37.0
3	Norway	34.5
4	Switzerland	33.8
5	Korea	32.8
6	Iceland	32.8
7	Sweden	31.6
8	Luxembourg	31.3
9	Finland	29.7
10	Canada	29.7
11	Germany	29.3
12	France	29.1
13	United Kingdom	28.9
14	Belgium	28.4
15	United States	26.7
16	Australia	24.9
17	Japan	24.2
18	New Zealand	22.8
19	Austria	21.8
20	Ireland	21.4
21	Spain	20.8
22	Italy	19.8
23	Czech Republic	18.1
24	Portugal	17.0
25	Greece	17.0
26	Hungary	16.8
27	Slovak Republic	12.6
28	Poland	11.3
29	Turkey	8.7
30	Mexico	8.4

Table 3.2. INTERNATIONAL PENETRATION RANKING OF THE U.S. IN YEARS 2001-2009 BASED ON OECD DATA FROM [HTTP://WWW.OECD.ORG/STI/ICT/BROADBAND](http://www.oecd.org/sti/ict/broadband).

Year	U.S. Rank out of the 30 OECD countries
2001, Q2	3
2002, Q2	6
2003, Q2	10
2004, Q2	12
2005, Q2	12
2006, Q2	13
2007, Q2	15
2008, Q2	15
2009, Q2	15

Figure 3.6.

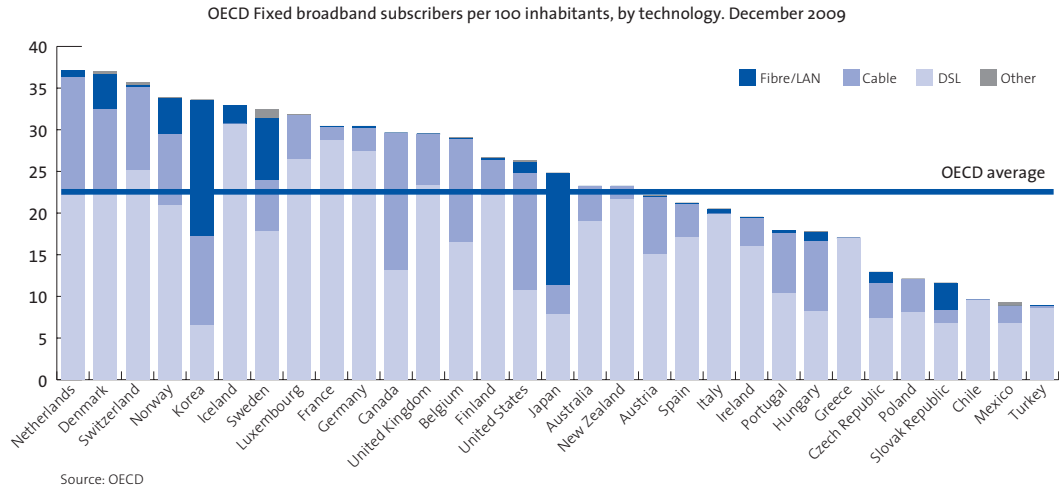


Figure 3.7. DETERIORATION OF U.S. BROADBAND RANKING IN OECD

