Vertical Relations and Connectivity in the Internet[¤]

Pinar Dogan[y]
Public Utility Research Center
University of Florida, USA.

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1 Introduction

The Internet is a "network of networks".[1] The e¤ectiveness of the Internet crucially depends on the interconnection among individual networks, which display a hierarchical structure (see Figure 1). At the bottom of the hierarchy, individuals and business enterprises use end-systems to connect to local Internet Service Providers (ISPs) through an access network. Local ISPs are connected to regional ISPs, which, in turn, serve as an interface point to the backbone layer. The backbone layer, which is the highest tier in the hierarchy, is built up by multiple interconnected backbone providers. There is a high concentration in the upstream backbone market, and it is well recognized that when the intermediary good –access to the backbone network– is not provided competitively, incentives for vertical control may arise.

In the Internet industry there are externalities that are derived from its vertical structure. Moreover, the industry is characterized by substantial network externalities. The bene…ts from network externalities do not depend only on the number of interconnected existing and potential subscribers, but also on the quality of this interconnection. In particular, real time services over the Internet (e.g. Internet telephony, video conferencing, etc.) can be enjoyed only if a good quality of interconnection is realized.[2]

In this paper I analyze how network externalities and the externalities due to the vertical structure may interact in networks' decisions for pricing and quality

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[y] E-mail: doganp@notes.cba.uf.edu

[1] The term "network of networks" was …st introduced by Eli M. Noam, and is extensively employed to de…ne the structure of the Internet.

[2] Reasons of poor quality other than strategic decisions (e.g. congestion, suboptimal routing) are beyond the scope of this paper.

of interconnection.[3] I argue that the installed base advantage of a backbone network resembles cost advantage in a price competition setting, when quality of interconnection among the upstream backbone networks is not perfect. For this reason, in a duopolistic setting the big backbone may prefer a very poor quality of interconnection with the other backbone. By degrading the quality of interconnection it can hold a markup over the price of access it provides to downstream ISPs. The size of this markup depends on the installed base difference between the backbone networks. I also argue that the big backbone may vertically integrate with a downstream ISP only if its installed base advantage is not very large. If vertical integration occurs, the integrated backbone may increase the non-integrated rival ISP's cost by charging a higher access price than it charges in the absence of integration.

The remainder of this paper is organized as follows. In Section 2, I briefly describe the vertical structure of the Internet. In Section 3, I review the literature on the strategic behavior of firms regarding horizontal interconnectivity in the Internet. In Section 4, based on Dogan (2001), I describe a successive duopoly setting in order to illustrate possible strategies concerning prices and qualities in providing access to the Internet within a local market. I look at two possible equilibrium structures –with and without vertical integration– and discuss the conditions under which firms may choose to integrate vertically. Finally, I summarize my findings.

2 Vertical Structure of the Internet

The vertical structure of the Internet displays a feature similar to "manufacturer-retailer" relationships. In this hierarchical structure, an ISP resembles a retail organization, whereas a backbone provider resembles a wholesaler. Residing at the very top of the hierarchy, backbone providers use fiber optic networks to provide point-to-point data transportation service and access to Network Access Points.

[3] My focus is on vertical relations between a backbone provider and an Internet service provider. Nevertheless, there are other type of vertical combinations, for example, of content providers and access providers (e.g. America Online/Time Warner) in the Internet industry. See Rubinfeld and Singer (2001) for how vertical integration of this type in broadband access market could lead to content or conduit discrimination by the integrated provider.

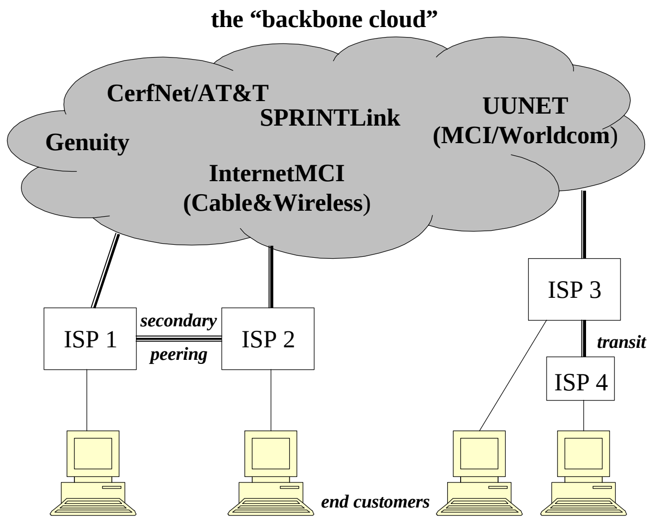

Figure 1: The industry structure

The first Internet backbone infrastructure, NSFNET, was constructed in 1986 by the National Science Foundation. NSFNET was the top tier of a three-layer hierarchy. The second tier was made up of mid-level networks, and the third was Local Area Networks which were connected to the mid-level network.[4] The NSFNET backbone was shut down on April 1995 after the US government decided to stop funding it. In the aftermath of the privatization, the traffic has been carried on several privately-owned backbones. Major backbone providers, which currently carry about 80% of the Internet traffic, are UUNET Technologies (owned by MCI/Worldcom), InternetMCI (Cable&Wireless), SPRINTLink, Genuity (formerly GTE), and CerfNet/AT&T. These core backbones exchange traffic on the basis of peering agreements.[5]

There are high sunk costs associated with constructing a backbone network. Administrative and maintenance costs are also substantial. However, backbones with excess capacity carry traffic at zero incremental cost.[6] Backbones charge the connected ISPs a monthly fee, which typically depends on the bandwidth

[4] See MacKie-Mason and Varian (1998) for FAQs about the Internet, and Srinagesh (1998) for a more detailed explanation.

[5] Peering agreements imply that networks exchange traffic that is destined for their networks. Note that the peering agreements, which are on settlement free basis, are expected to appear among relatively equally sized backbones. Alternatively, networks can purchase transit from each other. Transit agreements typically appear between networks with asymmetric sizes, and the transit provider receives payments from the network for which it carries traffic. See Kende (2000) for a full discussion of interconnection agreements between the backbones. See also Filstrup (2001) for a formal discussion of the Internet interconnection agreements.

[6] See Gang and Srinagesh (1998).

capacity of the connection between the regional ISP and the backbone. Once the fixed-bandwidth connection is in place, the ISP can send and receive data up to the bandwidth of the connection. ISPs can either connect directly to one of the upper layer backbones (e.g., ISP 1 in Figure 1), or can purchase transit from another ISP (e.g., ISP 4 in Figure 1). Nevertheless, ISPs can also engage in secondary peering agreements through which they exchange the local traffic designated for their own customers without transporting data through the backbone network (e.g., ISP 1 and ISP 2 in Figure 1).

An ISP typically provides Internet access to end consumers which can be either individuals or business enterprises. However, ISPs do not only provide access to the Internet; they also provide value-added services, such as customer support, hardware, software, information and content provision.

Although some backbone networks may also operate at the ISP level, the markets for backbone networks and ISPs are separate. Indeed, in its decision[7] for the Worldcom/MCI merger, the European Commission (EC) defined top level networks (backbones) that provide universal Internet connectivity as a separate market. The EC applied a hypothetical monopoly test and showed that neither secondary peering ISPs, nor the resellers, were capable of significantly constraining the behavior of the top-level networks and preventing them from acting independently.[8]

The intermediary input, which is provided in a concentrated market, embodies substantial network externalities. Hence, stable interconnection among the backbone networks is extremely important and is essential for the reliability of the Internet. There is currently no central authority for monitoring the quality of interconnection. Although the Internet is engineered as a “best effort” network, in which parties commit to do their best in limiting delays, in the absence of regulatory policies it is unclear whether private incentives of the backbone networks would attain the socially desired quality of interconnection.

3 Network Externalities and Interconnectivity among the Backbone Networks

Strategies regarding what Besen and Farrell (1994) refer to as "horizontal compatibility" in non-physical networks resemble interconnectivity strategies among the physical networks. Whether physical or non-physical, when networks display positive externalities, a subscriber to any of the interconnected (compatible) network enjoys the benefits at the industry level, instead of the single network level. If the quality of interconnection among the networks is perfect (or the networks are fully compatible) all firms simply supply access to a single network, no matter what the nature of asymmetry of the firms might be. This raises the issue of private incentives of networks for maintaining a good level of interconnectivity

[7] See Commission Decision of 8 July 1998 (Case IV/M.1069 - Worldcom/MCI), 1999/287/EC, Official Journal of European Communities.

[8] Pure resellers transmit any price increase to the customer and secondary peering provides a limited substitutability.

or compatibility. In this regard, Katz and Shapiro (1994) note that a …rm with a distinct superiority (e.g. a larger installed base) is likely to prefer incompatibility, and hence, may spend sources to block compatibility. Similarly, Katz and Shapiro (1986) argue that a …rm may oppose compatibility if it expects to become a dominant supplier. Indeed, expectations of consumers about the competing products determine the compatibility strategies of the …rms.

Although the analogy can be made between degree of compatibility in non-physical networks and quality of interconnection in physical networks, the social tradeo¤ concerning the former versus variety and innovation[9] is not present for the latter in the Internet backbone network. As described in the previous section, backbone networks mainly provide point-to-point data transportation, which is more or less a standard service. Because this is the case, there is no debate about social desirability of good quality of interconnection among the backbone networks.[10] Quality of interconnection becomes more pertinent in developing real-time services over the Internet.

To the extent that positive externalities are present and the rival network may have di¤erent strategies regarding the quality of interconnection, the quality of service provided by a network does not solely depend on its own decision.[11] Crémer, Rey and Tirole (2000) study competition between two backbones with asymmetric installed bases by adapting the Katz and Shapiro (1995) model of sponsorship. They show that the backbone with a larger installed base may have incentives to degrade quality of interconnectivity, even when improving the quality of interconnection does not entail any costs. The result is very intuitive. Network externalities generate an element of vertical product di¤erentiation when the networks are not perfectly interconnected. The large backbone relies relatively less on access to the small backbone's installed base, and hence has a competitive advantage when the quality of interconnection is degraded. Foros and Hansen (2001) also model competition between two symmetric ISPs that own their backbone network. They show that a high level of quality of interconnection decreases competitive pressure on the ISPs when they o¤er differentiated products à-la-Hotelling.[12] They argue that They conclude that ISPs have no incentives to degrade quality of interconnection.[13] However, this re-

[9] Katz and Shapiro (1994) argue that if compatibility is achieved through standardization, it may prevent development of promising but unique and incompatible new systems, and hence, may reduce variety.

[10] However, imposing peering type of interconnection among backbones which have considerable size di¤erences, may result in under-investment in capacities. As Filstrup (2001) demonstrates, peering agreements must take place between relatively symmetric networks, otherwise small networks may free ride on large networks' infrastructure, which would result in under-investment. See Little and Wright (2000) for a formal discussion of how enforcement of settlement-free peering agreements among asymmetric …rms may adversely a¤ect investment in Internet infrastructure.

[11] Although in some cases compatibility decisions are unilateral (e.g., once can observe one-way compatible non-physical networks), interconnectivity in physical networks is by and large determined by the joint decision of di¤erent networks.

[12] Authors assume that ISPs achieve maximum horizontal di¤erentiation. Therefore when ISPs maintain a good quality of interconnection (hence, customers are willing to pay more for their service), they employ less aggressive pricing strategies, which give rise to higher pro…ts.

[13] There may be other quality considerations that arise due to network congestion or subop-

sult depends on the assumption that ISPs have no asymmetry with respect to installed bases.

Along with the network externalities that have been modeled explicitly in Crémer et al (2000) and Foros and Hansen (2001), there are externalities due to the vertical structure of the Internet. In Dogan (2001), I study the strategic consequences of the interplay between these two types of externalities. I add an intermediate layer to the competition, and distinguish between ISPs that set the prices for end-users and the backbones that determine the quality of interconnection . In the following section I illustrate how new strategic issues may rise due to this distinction.

4 Competition within a Local Market

Let us consider a setting in which two upstream backbones with asymmetric installed bases compete to provide connectivity to the downstream ISP market within a geographical market[14]. In this case the installed base of a backbone re‡ects the number of customers in the rest of the world that are connected to that backbone network. Therefore, between the two interconnected backbones, one is "bigger" than the other.

ISPs buy unit connectivity from one of the upstream backbone, and provide access to the Internet for the end customers. Although there are about 3,000 local ISPs in Western Europe and more than 6,000 in the United States, the number of local providers within a geographical market, e.g., a country or a city, is small.[15] For simplicity, let us consider only two ISPs that di¤erentiate their services and compete with prices for this local market. Indeed, ISPs customize their service for special needs and requirements of the users, by o¤ering di¤erent combinations of services, such as basic access, frontier access, networking, and hosting. Since degree of di¤erentiation among the ISPs is not the focus of this paper, I consider the ISPs as achieving maximum horizontal di¤erentiation.

Consumers who can be either businesses or residential users derive utility from having access to the Internet. Consumers' utility, and hence their willingness to pay, depends both on the number of other people connected to the Internet and on quality of interconnection. Similar to Crémer et al., I assume that backbone networks have perfect quality of connection on-net.[16]

Therefore, the customers who are in the same backbone network enjoy a perfect quality of interconnection. As a direct implication, subscribers of the same

timal network routing. However, the focus of this paper is strategic quality decisions. Similar to Crémer et al., I assume that the backbone network, which has a lower preference over the quality, determines the …nal quality of interconnection.

[14] The analytical framework is based on Dogan (2001). See Dogan (2001) for a more detailed and formal analysis.

[15] For example, Greenstein (1999) states that in the US in the fall of 1998, only in the counties with populations above 30,000 does the average number of national ISPs exceed one. See also Downes and Greenstein (1998), Table 1.

[16] This assumption is extensively employed by the network competition literature. However, see Jamison (2001), who demonstrates that networks may prefer an imperfect internal quality.

ISP (e.g., A1 and A2 in Figure 2a and 2b) enjoy perfect quality of connectivity.[17]

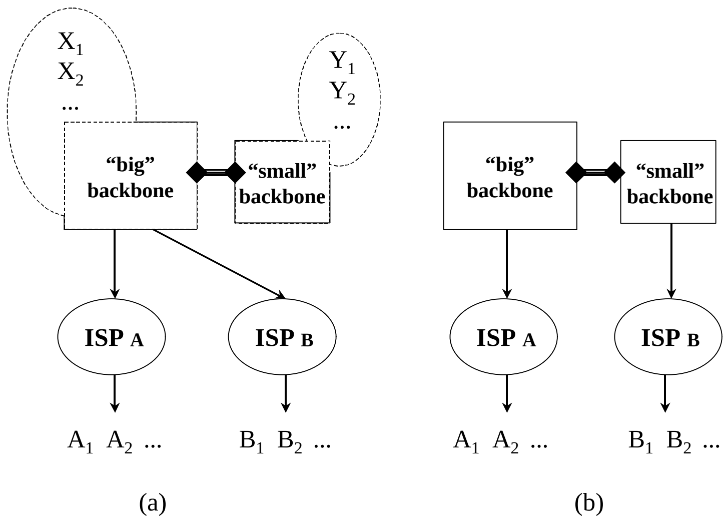

Figure 2: Examples of possible connectivity con…gurations

The quality of connection among subscribers of di¤erent ISPs depends on whether or not the two ISPs are connected to the same backbone network. If the ISPs are connected to the same backbone network (e.g., Figure 2a), then their subscribers of di¤erent ISPs (e.g., A1 or B1 in Figure 2a) enjoy perfect quality of interconnection. If the ISPs are connected to di¤erent backbones (e.g., Figure 2b), the quality of connection among their customers (e.g., A1 and B1 in Figure 2b) is determined by the quality of interconnection between the two backbone networks.

Similarly, quality of connectivity between a customer in this local market and a customer in another geographical market depends on their ISP's connectivity to the backbone network. For example in Figure 2a, the quality of connection between A1 and Y1 (who is in another geographical market and has connectivity through the small backbone) is determined by the quality of interconnectivity between the two backbones. However, the quality of connectivity between A1 and X1 (who is part of the installed base of the big backbone) in Figure 2a is perfect as they are connected to the same backbone network. Finally, the quality of interconnection between the big and the small backbone is determined by the backbone which has a lower preference over the quality.

Having described the general setting, I analyze two possible equilibrium structures –competition with no vertical integration and competition with vertical integration– separately.

[17]Customers may connect to each other for e-mails, Internet fax as well as for real-time services like Internet telephony, chat, video conferencing etc.

4.1 Competition with no Vertical Integration

The competition layout when there is no integration is presented in Figure 2a. I begin by examining the backbone choice of ISP A and ISP B. First, let us consider the case in which the backbones are interconnected with a perfect quality. Clearly, in this case there is no di¤erence between connecting to a big or a small backbone network. When the ISPs become connected to any of the backbones, their customers simply enjoy the externalities of the whole network at perfect quality. Perfect interconnection makes the backbones equivalent from the viewpoint of their customers, and price competition between the backbones drives prices to marginal cost.

The size of two backbones matters only if the quality of interconnection among the backbones is imperfect. In that case, consumers would rather be part of larger network because they would have a perfect quality of interconnection for a larger customer base. As a result, ISPs would prefer to have connection to the larger network. When ISPs connect to the same backbone they derive exactly the same symmetric payo¤s. This is because ISPs compete for the same local market and when they connect to the same backbone their products are equivalent in quality terms. One can model the system such that ISPs share the market equally, and their pro…ts are independent of the price of the connectivity as that price is entirely transferred to the end customers. However, for any ISP, it is a risky strategy to connect to the small backbone, as an ISP cannot be sure of its rival's backbone choice.

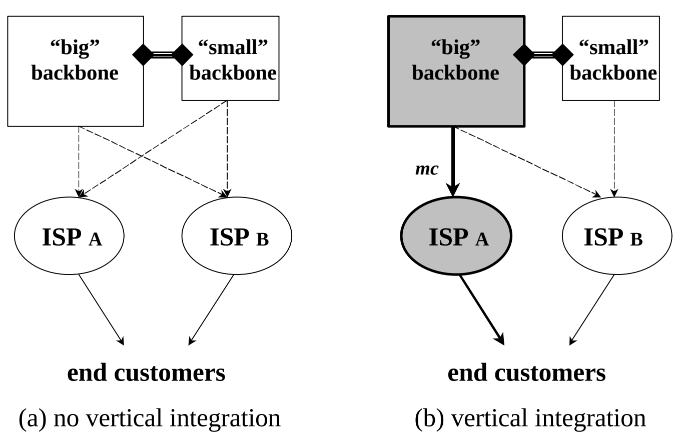

Figure 3: Competition layout without and with vertical integration

The very nature of this coordination problem grants the big backbone some pricing discretion depending on the degree of connectivity.[18] By degrading the quality of interconnection, the larger backbone vertically di¤erentiates its otherwise undi¤erentiated product, and obtains a quality advantage. Given that ISPs are assumed to be unable to coordinate[19], they both have a preference for a better quality of service. Hence, the larger backbone covers the market and obtains a markup which re‡ects its installed base advantage. The installed base advantage of the big backbone depends on the installed base di¤erence between the two backbones (i.e., on how much "bigger" the big backbone is), and also on the degree of quality degradation. The greater the degradation, the more economically bene…cial it is to be a larger network, which is re‡ected in higher markups over the price of connection. As a result, the large backbone prefers the lowest possible quality of interconnection.

This argument depends critically on the implicit assumption that the existing customers (the installed base) are "locked in", and do not switch providers as a result of the poor quality of connectivity. They may be locked in because backbones o¤er ISPs favorable terms for long-term engagements, or switching to another backbone provider may be too costly.

The installed base advantage of the large backbone is analogous to a cost advantage in price competition. The price of the small backbone is driven to its marginal cost, whereas the large backbone obtains a markup, which amounts to its installed base advantage, and covers the entire market. Even though the small backbone has no ISP as a customer in this geographical market, its presence disciplines the market power of the large backbone. However, the large backbone cannot charge too high a price, as this might lead both ISPs to get connection from the small backbone.

When the big backbone decides on the quality of interconnection it does not internalize the e¤ect of this choice on the customer surplus, or on pro…ts of the other …rms. If the big backbone was the sole supplier in this local market, it would have no incentive to degrade quality of interconnection. By keeping the quality of interconnection perfect with the other backbones in other geographical markets, it would extract all the rent from end customers who value having good quality of interconnection.[20]

4.2 Competition with Vertical Integration

In this section, let us consider an industrial structure, which is the same as in the preceding section. Let us now assume however, that the big backbone integrates with ISP A.[21] See Figure 3b for the competition layout. In Figure

[18] Note that I have considered backbones as making their price o¤ers for the ISPs publicly and simultaneously. The arguments above do not hold when sequential contracting is allowed. In particular, commitment of any of the ISPs to buy connectivity from, say, the big backbone would result with a higher unit price o¤ered by the backbone to the next ISP in line.

[19] I ignore the possibility of secondary peering agreements among the ISPs.

[20] I do not consider the possibility of side payments here, which could, under certain conditions, yield a better quality of interconnection.

[21] As ISPs are symmetric, there is no loss of generality in assuming integration with ISPA. Furthermore, as I argue in Section 4.3, integration between the small backbone and an ISP

3b, the vertically integrated backbone provides connection to its downstream division at marginal cost.[22] In this setting, in contrast to the previous setting there is no coordination problem between the ISPs, and the backbones compete only for the non-integrated ISP (ISP B).

Having added ISP A and, therefore that ISPs potential customers in this market, to its installed base, the vertically integrated backbone can charge ISP B a price higher than it would in the absence of vertical integration. Indeed, it charges a price such that ISP B is slightly better o¤ by connecting to the big backbone, than to of the small backbone. As in the …rst setting with no vertical integration, the big backbone prefers the quality of interconnection at the lowest possible level, as the price it can charge to ISP B decreases with the quality of interconnection.

The forces that derive the pricing strategy of the integrated backbone are straightforward. Let us consider the case in which both backbones charge too high a price to ISP B, so that ISP B gets a zero market share when it buys connectivity from any of the backbones and eventually withdraws from the market. This cannot be an equilibrium outcome as the small backbone would have an incentive to charge a su¢ ciently low price to induce ISP B to buy connectivity from it. However, the big backbone is better o¤ by selling connectivity to ISP B, therefore, it charges the maximum price given that ISP B chooses to buy connectivity from it. Not surprisingly, this price is higher than the price it charges when there is no integration. The di¤erence between those two prices –with and without vertical integration– increases in both the magnitude of network externalities and the installed base di¤erence.

As a result, ISP B has a cost disadvantage in the downstream competition, and always charges a higher price than the integrated ISP A.[23] ISP B obtains a lower market share, and hence, a lower pro…t than in the absence of vertical integration. The larger the di¤erence, the lower the pro…t obtained by the ISP B.

Nevertheless, depending on the magnitude of network externalities and installed base di¤erences, …nal prices when vertical integration occurs may be lower or higher than the prices when there integration does not occur. For relatively large magnitude of installed base di¤erence, the …nal prices when there is no integration may be greater than the prices when there is integration. This is because when there is no integration the price charged by the big backbone to both of the ISPs increases with the installed base di¤erence. When there is integration, the price charged to the non-integrated ISP also increases with the installed base di¤erence, but at a slower rate than when there is no integra-

dose not occur.

[22] I do not consider the case where the integrated backbone commits to charge a positive price to its downstream ISP (ISP A), as the internal price is not observable by the non-integrated ISP (ISP B).

[23] When vertical integration occurs for any positive connectivity price of the integrated …rm, the reaction function of the non-integrated ISP is ‡atter than that of the integrated …rm, as the integrated …rm obtains the intermediary input at a price of zero. Thus, for a given degree of externalities, a higher installed base di¤erence yields a higher access price charged by the integrated backbone, and hence a larger di¤erence among the prices of the IPSs.

tion. Furthermore, integration mitigates double-marginalization between the integrated …rms.

4.3 Incentives for Vertical Integration

Having discussed possible equilibrium structures –with and without vertical integration–, in this section I argue the conditions under which vertical integration is more likely to occur.

In this setting big backbone integrates with one of the ISP only if the installed base di¤erence between the two backbones is su¢ ciently small. The installed base advantage here is similar to a cost advantage of an upstream …rm. To understand why this is the case, consider the extreme situation in which the installed base di¤erence is in…nite. It is exactly equivalent to the case where one of upstream …rms has an in…nite cost of producing the intermediary good (the small backbone). Then the more e¢ cient …rm (the larger backbone) has no incentive to integrate with a downstream …rm. The large backbone bene…ts more from having a relatively large installed base di¤erence when it sells connectivity to the whole downstream market. With a large installed base di¤erence it can commit itself to higher prices, which reduces price competition with the smaller backbone. This is true in this setting, as far as market coverage is assumed for the …nal market. The price of the connectivity is borne by the …nal customers; pro…ts of the ISPs do not depend on the price of connectivity as long as the ISPs connect to the same backbone. Moreover, when the installed base di¤erence is relatively small, the integrated …rm's pro…ts in the …nal market become signi…cant as a portion of its total pro…ts, and vertical integration becomes a pro…table strategy.[24]

There is no incentive for any vertical integration between the small backbone and an ISP. To understand why, …rst, consider the case in which the large backbone does not integrate with ISP A. As buying connectivity from the small backbone at zero price is always an option, but not a pro…table one, no integration would occur (as the total pro…ts realized by integration would not be larger than the sum of the pro…ts realized by without integration). Second, consider the case in which the large backbone integrates with ISP A. I have already argued that in this case the integrated backbone charges a price such that the ISP B connects to its network, and it has no incentive to charge a higher price (which would be equivalent to refusing to supply). Thus, for the same reasoning, no vertical integration will be observed between the small backbone and ISP B.

In the setting I have described, vertical integration always harms social welfare, although for relatively large installed base di¤erences consumer welfare may be improved. There are two con‡icting e¤ects on the …nal price. First, vertical integration mitigates double-marginalization among the integrated …rms. Second, the integrated backbone charges the non-integrated ISP a higher price

[24] However, if a transfer price is allowed among the integrated …rms, "no vertical integration outcome" could be replicated.

than it would in the absence of integration.[25] Moreover, with relatively small installed base di¤erences, integration improves industry pro…ts. The pro…t loss of the non-integrated ISP in situation where the other ISP is integrated with the upstream backbone (compared to that of the situation where none of the ISPs are integrated) is o¤set by the increase in the integrated …rm's downstream pro…ts. Social welfare is reduced more when the integrated upstream backbone has a larger installed base di¤erence.

5 Conclusion

Incentives for vertical control –with or without integration– may rise whenever the intermediary input is not supplied competitively. High concentration in the Internet backbone market and the magnitude of network externalities in the industry suggest a closer examination of vertical relations. In particular, when there is an asymmetry among the competing backbones, the backbone with a larger installed base may transform this advantage to a market power by degrading the quality of interconnection. Furthermore, due to its installed base advantage, the integrated backbone may also raise the cost of access to non-integrated downstream rivals and still retain them as customers.

Some of the backbone providers (e.g. Worldcom-UUNET) operate their own vertically integrated ISPs. Some others have strategic alliances (e.g., in February 1998, Sprint and one of the major ISP in the US, EarthLink, announced a long-term strategic alliance to create a single, uni…ed Internet service) with downstream ISPs. In June 2000, the Federal Communications Commission approved the merger between AT&T and Media One group[26], the third largest cable company of the US. The combined company is expected to become the US's largest cable operator with an objective of providing high-speed Internet access.

Although it is very di¢cult to assess how those vertical relations may a¤ect overall social welfare, the key lesson from this analytic framework is that the combination of vertical externalities and network externalities may facilitate cost raising strategies for a vertically integrated backbone.

[25] In this setting, vertical integration never causes exit by any of the non integrated …rms, hence the integrated …rm cannot monopolize the …nal market.

[26] AT&T and MediaOne merger raised also horizontal issues as the merged entity exceeded the horizontal ownership limits for the cable networks that is set by the FCC. Another concern was that by bundling the Internet access to the cable subscription the merged entity would prohibit the cable subscribers from selecting another ISP, and hence would restrict vertical competition.

References

[1] BAILEY J. P. (1998): “The Economics of Internet Interconnection Agreements” in ”Internet Economics”; ed. Mc Knight, L. W. and Bailey, J. P., MIT Press.

[2] BESEN S. M. and FARRELL J (1994).; “Choosing How to Compete: Strategies and Tactics in Standardization”, Journal of Economic Perspectives, Vol.8(2), pp. 117-131.

[3] CRÉMER J., REY P. and TIROLE J. (2000): “Connectivity in the Commercial Internet”, Journal of Industrial Economics, Vol.48, pp. 433-472.

[4] COMMISSION DECISION of 8 July 1998 (Case IV/M.1069 - Worldcom/MCI), 1999/287/EC, O¢cial Journal of European Communities.

[5] DOGAN P. (2001): “Vertical Integration in the Internet Industry”, mimeo.

[6] DOWNES T. A. and GREENSTEIN S. M. (1998): “Do Commercial ISPs Provide Universal Access?”, http:/ /skew2.kellog.nwu.edu/ ~greenste/ research/ papers/ tprcbook.pdf/.

[7] FILSTRUP B. (2001): “Internet Interconnection Agreements”, http:// www.eecs.umich.edu/ ~b…lstru/interconnection.pdf/.

[8] FOROS Ø. and HANSEN B. (2001): “Competition and compatibility among Internet Service Providers”, Journal of Information Economics and Policy, Vol.13(4), pp. 411-425.

[9] GONG J. and SRINAGESH P. (1998): “The Economics of Layered Networks”, in ”Internet Economics”; ed. Mc Knight, L. W. and Bailey, J, P., MIT Press.

[10] GREENSTEIN S. (1999): “Understanding the Evolving Structure of Commercial Internet Markets”.

[11] JAMSION M. (2001): “Network Externalities, Mergers, and Industry Concentration”; PURC Working Papers.

[12] KATZ M. and SHAPIRO C. (1985): “Network Externalities, Competition and Compatibility” American Economic Review, Vol.75(3), pp. 424-440.

[13] KATZ M. and SHAPIRO C. (1986): “Technology Adoption in the Presence of Network Externalities”, Journal of Political Economy, Vol. 94, pp. 822-841.

[14] KATZ M. and SHAPIRO C. (1994): “Systems Competition and Network E¤ects”, Journal of Economic Perspectives, Vol.(8)2, pp. 93-115.

[15] KENDE M. (2000): “The Digital Handshake: Connecting Internet Backbones”, OPP Working Paper No.32, FCC, http:// www.fcc.gov/ Bureaus/ OPP/ working_papers/ oppwp32.pdf/.

[16] MacKIE-MASON J. K. and VARIAN H. R. (1998): "Economic FAQs About the Internet"; in "Internet Economics"; ed. Mc Knight, L. W. and Bailey, J. P, MIT Press.

[17] LITTLE I. and WRIGHT J. (2000): "Peering and Settlement in the Internet", Journal of Regulatory Economics, Vol.18(2), pp. 151-173.

[18] RUBINFELD D. and SINGER H. J. (2001): "Vertical Foreclosure in Broadband Access?", Journal of Industrial Economics, Vol.49(3), pp. 299-318.

[19] SRINAGESH P. (1998): "Internet Cost Structures and Interconnection Agreements", in "Internet Economics"; ed. Mc Knight, L. W. and Bailey, J. P., MIT Press 1998.