Understanding Vertical Integration in the Internet

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The Internet industry is undergoing rapid change as a consequence of telecommunications deregulation, growth in the demand for and supply of IP-based services and products, and the need and desire to provide integrated, voice, video and data services on a single network platform. Currently, the public Internet runs on infrastructure that is owned by a combination of internet service providers (ISPs) and traditional telephone companies. In the United States, there are over 4,000 ISPs, ranging in size from small "mom and pop" operations that provide basic Internet access services to large international backbone providers. In the United States, there are currently 32 backbone ISPs (Table 1). These ISPs rely on transport services provided by the more than 1,600 traditional facilities-based local and long distance telephone service providers (Table 2).

This industry structure is largely a consequence of legacy regulation and network design. Historically, telephone service providers were subject to rate regulations and line of business restrictions, under the presumption that these were a natural monopoly. Traditional telephone networks were optimized to support a single service, 4KHz voice telephony. The need to support universal service in a network comprised of multi-vintage, long-lived infrastructure deterred anything more than incremental service innovation. Although the quality of service and reliability of telephone service have increased dramatically while the real price of service has fallen dramatically, the basic functionality of plain old telephone service remains largely unchanged since its introduction. Integrated digital services are still not widely available. Telecommunications deregulation and the development of new wireless and local access technologies such as LDMS, xDSL, wireless fixed loops, and cable modems, enhance prospects for increased local telephone competition and an expansion in the range of services offered by traditional infrastructure providers. For example, cable systems operators adding telephone service; local telephone companies adding video and Internet access services; and long distance companies offering local telephone service.

[1] This paper builds on earlier work with Dave Clark prepared on behalf of the Massachusetts Institute of Technology's Internet Telephony Consortium (MIT ITC) that was presented in a draft paper by the author entitled *Vertical Integration and Internet Industry Structure: An Application of the Pricing Taxonomy* at the ITC meeting in Cambridge, MA, November 1997.

This changed environment has promoted significant restructuring in the participating industries. In addition to new entrants at all levels within the value chain, there have been numerous horizontal and vertical mergers, divestitures, and restructurings (Table 3). The goal of this paper is to present an analytical framework to examine incentives of service providers at various stages in the service provider value chain to vertically integrate. The focus is on residential, dial-up subscribers to simplify the analysis.[2] The goal of the paper is to address the following sorts of questions:

- What are the incentives of firms at various stages in the value chain to vertically integrate?
- What does this imply for Internet industry structure today and in the future?
- Is the market for a commodity IP bearer service sustainable?[3]

The paper is organized into the following sections. Section I introduces a framework for evaluating industry structure. Section II reviews the economics of vertical integration and Section III uses this framework to evaluate incentives to vertically integrate in the Internet.

I. A framework for analyzing Internet industry structure

Following Coase (1937), we can investigate the boundaries of firm structure by considering the advantages of integrating production stages within a single firm relative to the alternative of using market exchange to transfer intermediate goods. The value-chain for internet services may be decomposed into the four essential elements that must be present in order to offer end-to-end internet services. These include the following:

(1) Retail-level internet access provider (IAP)
(2) Local area transport services (LAT)
(3) Backbone internet transport services (ISP)
(4) Wide area transport services (WAT)

This retail-level IAP is the furthest downstream, providing Internet services to the consumer. To deliver its services, the IAP relies on the LAT to deliver traffic from the customer's premises to the IAP's Point of Presence (POP) and from the IAP's POP to the backbone ISP's network. The backbone ISP provides the IAP with connectivity and transport services to the rest of the Internet. The ISP may lease bulk transport capacity from WAT providers. These activities may be combined within a single fully-integrated

[2] Large commercial customers are more complex because they are more heterogeneous and because they face a larger array of outside options. Examining the behavior of large commercial customers requires considering their needs for intranet services and their decisions to self-provision, which means that one must examine interactions between equipment vendors and service providers. Because all of the challenges/opportunities present in residential (or small business) Internet service markets are present in commercial markets as well, focusing on the former provides a good starting point.

[3] I am referring to the model for an IP bearer service market outlined in Clark (1995) and the National Research Council (1996) report.

firm,[4] may be provided by four independent firms,[5] or some combination of partially integrated firms. Considering all possible combinations, there are 13 different types of firms that might exist (Table 4). An industry structure would consist of some combination of these 13 firms.

The value chain above gives rise to five potential types of market transactions between activities as follows (see Table 5a and Table 5b):

(1) Customer – IAP
(2) IAP – ISP
(3) ISP – ISP
(4) IAP – LAT
(5) ISP – WAT

Each of these transactions involves different types of participants, yet all are related in so far as the customers are the ultimate source of revenue which can be captured by the suppliers at successive stages in the value chain.[6] While the aggregate willingness-to-pay or final demand of the customers sets an upper bound on the total revenues which can be transferred from customers to suppliers, the aggregate costs of suppliers set a lower bound on the amount of revenue which must be extracted in order to make the service viable. The difference between these two sets the amount of surplus which can be generated in these markets. Each of the these transactions could take place either in an open market between independent firms or as an internal transfer within an integrated firm.

If each of the supplier markets is competitive, then all of the surplus will be captured by consumers and prices will be no higher at each interface than is required to recover costs. In the more realistic case where firms in one or more of these supplier markets possess market power, we may observe a much more complex array of strategic interactions. Firms may have incentives to exploit their control of bottleneck facilities (e.g., LAT providers) to extract additional surplus. Any sort of entry barrier (e.g., regulatory restrictions, scale economies, sunk costs, customer switching costs) can provide the basis for market power. Generically, firms prefer suppliers in other

[4] For example, in many countries the PTT provides both long distance and local telephone services and Internet access.

[5] For example, in the United States, there are local IAPs that rely on local telephone carriers to deliver traffic to their POP and from their POP to the ISP that provides them with Internet backbone services. The ISP may lease its transport facilities from interexchange carriers.

[6] We ignore the possibility of separate contracting arrangements between the end-user and other stages in the value chain (e.g., separate service contracting for IAP and ISP services) on the grounds that such relationships seem unlikely for residential consumers. Large commercial customers are more likely to consider this a viable option because they consider private networks and use of the PSTN as substitutes. The largest corporations are likely to have complex pricing agreements will players at all levels in the value chain.

stages of the value chain to face as stiff competition because this weakens their relative bargaining position.

To understand incentives to vertically integrate in the Internet industry, one must consider the characteristics and cost structure of each of the production activities in the framework. These may be summarized as follows (see Table 6a and Table 6b):

- Internet Access Provider (IAP): internet service retailer

  The IAP is the service provider of dial-up access to the residential consumer.[7] The IAP provides basic internet access, email, and Web hosting services that are delivered over facilities leased from the telephone company (the LAT) and from ISPs or WATs (the Internet cloud). The IAP is the downstream retailer or reseller of ISP transport services. There are a wide array of IAPs, ranging from "mom and pop" operations offering service to a small number of subscribers in a specific locale to national IAPs that offer access across the country (e.g., AOL, Mindspring), and are typically vertically integrated ISPs (or even, facilities providers such as AT&T).

  The IAP has the cost structure of a retail firm. Operating expenses include (1) corporate overhead; (2) sales and marketing; (3) customer service; (4) and telco and ISP service fees for leased transport services. The capital equipment owned by the IAP includes modem banks (to support dial-up access) and the servers (WEB hosting, email, file server).

  Entry costs to become a local IAP are low and this is the least capital intensive of the activities considered. There are only limited opportunities to realize capital scale economies (*i.e.,* modems and servers reflect constant returns to scale).

- Internet Service Provider (ISP) : internet service wholesaler

  The ISP offers IP connectivity to the Internet cloud for the IAP and provides backbone transport (this includes routing and basic transport). The ISP is the upstream supplier of Internet services to the IAP. Most of the ISPs are integrated forward into IAP services. These may be regional or national service providers such as UUNET.

  The ISP has the cost structure of a wholesale facilities provider. Operating expenses include corporate overhead, network operations (maintenance,

[7] As noted earlier, we will focus on the model of providing service to residential consumers to ease the discussion. Service to commercial customers is inherently more complex and heterogeneous because they have a larger array of needs and a wider selection of outside options for meeting those needs.

network planning), and telco (and perhaps other ISP) service fees for transport.[8] Capital equipment includes the Internet routers, gateways and some backbone transport facilities.

The ISP is more capital intensive than the IAP, but less so than the facilities-based providers (*i.e.*, LAT and WAT). Setting up and operating a national IP network (even on leased WAT facilities) and managing the interconnection arrangements to IAPs and other ISPs present significant entry barriers.

- Local Area Transport (LAT): local access facilities provider

  The LAT is the upstream supplier of the underlying physical infrastructure to support IAP access. For dial-up access, this is usually the telephone Local Exchange Carrier (LEC).[9] The existing physical access infrastructure supports other types of service besides Internet access (telephone calling, cable television).

  The LAT has the cost structure of a wholesale facilities provider such as an LEC. Operating expenses include corporate overhead, network operations, retail-level costs (e.g., for telephone service). Capital costs include local distribution plant and local switching, as well as the billing and signalling network infrastructure.

  The LAT is the most capital intensive activity in the value chain. Today, LAT services are provided by monopoly LECs, whose core business is providing local telephone access and calling services in a contiguous geographic area. As a consequence, the LECs remain heavily regulated both with respect to interconnection policies, prices, and market participation. Regulatory policy is seeking to promote competition in local services, and if successful, de-regulation. In the future (near?), cable TV companies and wireless providers (longer term?) may provide competitive local access alternatives.

- Wide Area Transport (WAT): wide area transport provider

  The WAT is the upstream supplier of the underlying physical infrastructure to support the ISP. These are typically long distance carriers. The WAT are the wide area analog to the LAT firms.

  The WAT has the cost structure of a wholesale facilities provider such as an telephone interexchange carrier (IXC). Operating expenses include corporate

[8] Typically, backbone providers peer with other backbone providers using "bill and keep," wherein they each agree to terminate each other's traffic at no cost. Larger ISPs may decline to peer with lower level regional ISPs and require them to pay capacity or usage sensitive transport fees.

[9] Although in the future it may include other types of local access providers such as community TV providers (cable) using cable modems, or wireless providers (e.g., PCS, mobile cellular, spread spectrum, etc.).

overhead, network operations, retail-level costs (e.g., for telephone service). Capital costs include long distance switching and transport plant, as well as the billing and signalling network infrastructure.

The WAT is also quite capital intensive, but significantly less so than for a LAT. Because WAT markets are much larger geographically[10] and less capital intensive, effective competition already exists in U.S. long distance telephone markets. Consequently, long distance carriers are subject to significantly less regulatory oversight.

II. Review of the economic theory of vertical integration[11]

Although much of the discussion will proceed as if the choice between vertical integration and market-based transactions is dichotomous, in reality, there are a continuum of organizational forms. They range from arm's length, anonymous, "take-it-or-leave-it" market transactions (e.g., as in competitive markets) to term commitments to complex bilateral contracts to full vertical integration (i.e., consolidated ownership). The more likely it is that the buyer and seller interact in a non-anonymous fashion, the more likely their interactions will be constrained by implicit or explicit contracts that will reflect vertical integration[12].

There are a number of motivations for vertically integrating.[13] These include:

- *(1) Scale and scope economies*: average costs are reduced through vertical integration because of the existence of fixed shared costs.[14]
- *(2) Transaction costs*: internal transfers may be less expensive than market-based transactions (e.g., because of metering or contracting costs).
- *(3) Coordination and control*: there are co-specialized assets[15] in the multiple stages that are more valuable if used together in a coordinated fashion.

[10] That is, local access markets are very local --- local access plant that does not pass a home does not offer a viable substitute, whereas in long distance services, switches in San Francisco and San Jose can offer competing long distance services.

[11] There is an extensive economics literature on vertical integration, including the following: Grossman and Hart (1986), Krattenmaker and Salop (1986), Perry(1989), Katz (1989), Riordan and Salop (1995), Williamson (1987).

[12] An expectation of repeated future interactions can give rise to implicit contracts (a la repeated games).

[13] Horizontal integration increases market share. The principal motivations for horizontal integration are to (1) scale and scope economies; (2) extend or protect market power (monopoly -- over buyers; monopsony -- over suppliers).

[14] This may include reductions in the costs of managing risk (i.e., insurance) as when an upstream supplier sells into diverse downstream markets subject to uncorrelated demand shocks. This reduces diversifiable risk in the form of demand uncertainty (analogous to investing in a market portfolio rather than a single stock).

[15] Co-specialized assets are assets that are more valuable when used together in a coordinated way. The classic example is a coal mine and the rail facilities that serve that coal mine. Independent ownership of these assets can result in excessive bargaining costs as each player tries to "hold-up" the other.

- *(4) Product differentiation or price discrimination*: downstream integration to facilitate price discrimination may be necessary for cost recovery (*e.g.,* the market for an undifferentiated upstream IP bearer service may be unsustainable[16]).
- *(5) Innovation and strategic positioning*: firm may need to vertically integrate if new product and upstream (downstream) firms do not exist.[17] Or, firm may vertically integrate to develop complementary skills to enhance its strategic position.[18]
- *(6) Market power*: integration to protect or extend (leverage) market power is a common motivation that is hypothesized for vertical integration. This may also include a desire to protect quasi-rents associated with sunk investments (*e.g.,* guarantee cost recovery of facilities investment).

The first five motivations are all efficiency-enhancing (*i.e.,* cost-reducing) and public policy should wish to encourage vertical integration that can be justified on these grounds; whereas the last motivation is likely to be opposed by public policy.[19] Historically, U.S. antitrust policy proscribed a number of vertical relationships as inherently anticompetitive (*e.g.* exclusive franchises, tying, etc.). Subsequent economic theory has raised serious doubts about *per se* restrictions against vertical integration by identifying efficiency-enhancing motivations that are not anticompetitive (see above), and by calling into question the effectiveness of vertical integration as a strategy to extend market power. For example, if the downstream (or upstream) market is already competitive, then vertical integration to extend market power may not make sense. [20]

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[16] Gong and Srinagesh (1996) argue that a competitive market for an undifferentiated bearer service may be unsustainable because of the existence of substantial sunk costs, the likelihood of excess capacity, and aggressive "Bertrand-like" price competition that would prohibit cost recovery. According to Gong and Srinagesh, to resolve this dilemma upstream suppliers of bearer services will need to integrate forward to differentiate themselves or will use long term contracts to shift the risk of cost recovery towards downstream customers. Kavassalis, Lee, and Bailey (1997) disagree with this assessment arguing that the bearer service market need not be a commodity because service-providers will be able to successfully differentiate their bearer services. These issues will be discussed at greater length below.

[17] For example, ITel software company may have to integrate backwards to produce board-level product if no supplier can be found to provide. Or, upstream supplier may need to integrate forward to develop new distribution channels for new product.

[18] Firm may vertically integrate to acquire additional skills and expertise, especially in technologically complex environments.

[19] Public review of mergers by the U.S. Department of Justice focus on the likely effect of the merger on competition. For horizontal mergers, the focus is on post-merger market concentration. The analysis of vertical mergers is inherently more complex.

[20] If the target market is already competitive, then prices should not exceed economic costs. Moreover, the firm with market power should be able to extract its monopoly rents without forward (backward) integration by pricing its goods at monopoly levels. Vertical integration to establish market power over a previously competitive market is often difficult unless it is possible for the entering firm to force the exit of competitors and erect entry barriers that will prevent re-entry.

Potential rationales for vertical integration to extend market power include the desire to avoid regulation[21] or to protect market power in a core market.[22]

In the following discussion, we will examine the costs and benefits of each of the suppliers in the value chain to vertically integrate with adjacent stages.

III. Vertical Integration in the Internet

With this industry taxonomy, we can explore opportunities to both vertically and horizontally integrate. The natural question to ask is what types of firms exist today and what types of firms may exist in the future.

The industry taxonomy discussed above partitions the internet service function into retail (IAP) and wholesale (ISP) services that utilize the capacity of local (LAT) and wide area (WAT) facilities providers. With these four types of activities, there are 13 possible types of firms and it is possible that multiple types will co-exist simultaneously (Table 4).[23] In the future, we expect to have an even larger number of possible firm configurations. The overall conclusions/predictions that emerge from this analysis include (Table 7):

- (1) ***Incentives to vertically integrate in the Internet are strong*****:** incentives to vertically integrate are strong at all stages within the value chain and so we should expect to see the emergence of fully-integrated facilities-based service providers.[24]
- (2) ***Viability of wholesale IP bearer service market*****:** availability of wholesale IP bearer services from these and other facilities-based providers will permit the continued existence of non-facilities based internet service providers, implying that the industry will consist of a variety of different types of firms.[25]
- (3) ***Downstream integration more likely than upstream:*** incentives to vertically integrate are asymmetric and are stronger for upstream firms to integrate downstream (i.e., ISP into IAP, LAT into IAP, WAT into ISP, LAT into WAT then reverse.)

[21] For example, an upstream provider of a bottleneck facility (e.g., local access services in telephone) may seek to integrate downstream to avoid price regulations intended to constrain monopoly power over the bottleneck facility.

[22] For example, if the upstream supplier has substantial sunk investments in sunk capacity, it may seek to integrate forward to deter competition that could destroy the quasi-rents associated with this sunk capacity.

[23] For example, today, we have standalone IAPs (e.g., TIAC), IAPs that are vertically integrated with ISPs but do not own wide area transport facilities (e.g., UUNET), and IAPs that vertically integrated with facilities-based ISPs (e.g., MCI).

[24] That is, IAP-ISP-LAT-WAT firms.

[25] That is, IAP and IAP-ISP firms that do not own facilities, but act as either pure or facilities-based resellers of underlying transport services.

- (4) ***ISPs will integrate into IAP services*****:** Standalone ISPs are unlikely because ISPs have a strong incentive to integrate into IAP services, and national IAPs have a strong incentive to maintain backbone facilities.
- (5) ***Facilities-based providers will integrate into internet services:*** standalone facilities-based providers (LAT, WAT) are unlikely because they have incentive to offer internet services to complement existing offerings (*e.g.,* telephone service) and to respond to competition from resellers (*i.e.,* ITel offered by non-facilities based providers in competition with traditional PSTN offerings).

The preceding conclusions are based on an assessment of key underlying trends and rely on several important assumptions. The key trends/factors are as follows:

- (1) ***One stop shopping*****:** consumers will demand and service providers will seek to offer one-stop shopping services that bundle multiple communication services into a single bill. One-stop shopping services will appeal especially to risk averse (reputation sensitive) and convenience-minded (less cost sensitive) consumers who will value the simplicity of consolidating multiple electronic bills. This will provide a strong market demand driver for vertical integration.
- (2) ***Scale and Scope Economies:*** there are significant retail-level scale and scope economies that encourage suppliers to offer "one-stop" shopping services. This is the cost-side driver for vertical integration. In addition, there are scale and scope economies associated with expanding nationally, or even internationally, which will also encourage vertical integration. See the further discussion of these below.
- (3) ***Open interface standards*****:** the Internet is distinguished, in part, by its reliance on and promotion of open interface standards that allow heterogeneous network environments to be flexibly interconnected. This means that is not essential to be vertically integrated to provide service, especially with respect to the network-related cost economies. Without such standards, vertical integration would be even more important and the viability of non-facilities-based providers or partial facilities-based providers would be suspect. The prevalence of such standards increases the relative importance of non-network cost economies (*i.e.,* retail-level costs, overhead costs).
- (4) ***Pro-competitive regulatory policy*****:** public policy would like to promote competition at all stages in the value chain. To the extent such policies are successful, they will promote the co-existence of both vertically integrated and non-integrated types of firms. The viability of these programs is most suspect with respect to the promotion of competition for local access facilities[26]. If competition is not successful here, then it is likely that local access will continue to be regulated as a bottleneck facility, with the potential for continued restrictions on access pricing, interconnection policies, and participation in adjacent markets. If facilities-based local access competition is not sustainable, then regulatory policy will be required to sustain non-fully integrated firms (e.g., equal access, common carriage, etc.). However, in this paper, I have assumed that local competition will be viable.

[26] That is, are local access facilities a natural monopoly?

- (5) ***Availability of Bandwidth*****:** the viability of an active reseller market for non-integrated carriers presumes the existence of a competitive wholesale market for facilities-based transport. This presumes that, generically, there will be excess capacity.[27] For WAT services, this already exists and will continue to exist in the future because of the relatively low entry costs and excess capacity in wide area transport.[28] For LAT services, today, access pricing is regulated and will continue to be regulated until there is effective competition. Because of the costs of installing local outside plant, when competition comes there is likely to be excess capacity.

The following sub-sections provide the reasoning behind each of the preceding five conclusions/predictions.

A. Incentives to vertically integrate in the internet are strong

There are strong incentives to vertically (and horizontally) integrate for each of the participants in the service provider value chain. Consideration of each of the motivations discussed above indicates that there are efficiency incentives to vertically integrate.

1. Scale and scope economies: yes

Scale and scope economies exist whenever there are large fixed or shared costs. Fixed costs do not vary with the volume of traffic actually handled (or number of customers served). Therefore, increasing the volume of traffic (or expanding the subscriber base) will decrease average total costs (scale economies). Shared costs are costs that cannot be uniquely assigned to a single product or customer. Therefore, expanding the number of customers served or products offered can result will reduce average total costs (scope economies). For all of the participants in the value chain, there are significant fixed and shared costs, giving rise to scale and scope economies that will encourage vertical integration. This can be best understood by reviewing the cost characteristics of each of the major cost categories.

- Network capital and operations costs
    - There are significant increasing returns to scale associated with capacity expansion costs. Because of the costs of installing outside plant, it is typical to install excess capacity to provide room for future growth.
    - Because of the need to size the network to accommodate peak demand, and because peak network demands are not perfectly correlated across domains, there is generically excess capacity in the network (although local bottlenecks may exist at different places and times in the Internet).

[27] The existence of excess capacity to support a facilities-resale market does not preclude congestion problems. I am presuming that usage pricing or admission control procedures will be adopted to address congestion problems such as wasteful use of the internet. What is necessary is that at any point in time there will be a carrier willing to lease local or long distance transport services to retail-only resellers.

[28] In the near term, this is not true for international service along certain routes; however, international capacity should be expanded rapidly.

    - Network operations expenses (planning, maintenance, management) are driven more by the network capacity than by the actual traffic handled. Also, network operations expenses may reflect increasing returns to scale (*i.e.,* it does not cost twice as much to manage a network twice the size.)[29]
    - Off-peak traffic shares peak capacity so assignment of costs is somewhat arbitrary and depends on classification of peak.
    - Also, end-to-end services share backbone capacity, especially in Internet where route may vary with each packet.
    - Large shared and fixed costs mean there are large scale and scope economies.
    - These are likely to be largest for LAT providers because these are more capital intensive than WAT. Similarly, network-related scale and scope economies are likely to be larger for ISPs then for IAPs.
    - There are likely to be some scale and scope economies from integrating local and long distance access network facilities. For example, these may come because some of the facilities used to support wide area transport services will be shared by local services (*e.g.,* tandem switches, signalling networks, intermachine trunks).
- Retail-level costs
    - Advertising costs show significant scale economies, and brand advertising yields scope economies. Brand advertising of a specific firm's name is likely to be especially important when reputation effects are important, as they may well be until consumers are more experienced and knowledgeable about Internet service options.
    - Customer service costs yield moderate scale economies because of these need to be sized for peak usage.
    - Bad debt yields moderate scale economies (because of diversification).
    - Product innovation and management costs are fixed.
    - Sales costs (customer acquisition costs) including original contact, setting up or modifying the customer account, etc. include a number of non-recurring charges that do not vary with the number of services sold to the customer. This is the retail-cost side of providing "one stop" shopping. These costs become more important as competition heats up and customer churn increases (reducing the amount of time over which non-recurring customer costs can be recovered).
    - Billing costs include a significant non-traffic sensitive component that does not vary when the customer is sold multiple services.
    - It is unclear whether there are significant scale and scope economies.
    - Retail-level scale and scope economies are perhaps not as large as network-level scale and scope economies in absolute terms, but they are likely to

[29] It is likely that the returns to scale for network management first decrease significantly (*i.e.,* very small networks are easy to manage, but quickly become more difficult as they grow larger -- extreme example, no problem with single computer becomes big problem with network of two computers), then increase over some range, and then eventually decrease again (*i.e.,* it is possible for a network to be too large).

become more important strategically as non-facilities-based providers become more important and as network-related costs become a smaller share of total costs.[30]

- Corporate overhead
  - Corporate overhead associated general support services and headquarters operations are largely fixed and shared across multiple services.
  - These will provide scale and scope economies from vertical integration.

Closely related to the above is the demand-side driver of network externalities (*i.e.,* it is more valuable to be connected to a larger network). In the absence of market power considerations, networks would choose to interconnect to expand the value of their networks.[31] The Internet promotes ubiquitous interconnection which means that smaller networks can share in the benefits of universal termination supported by larger networks.[32] Because these interconnection policies and settlements arrangements are currently in flux, smaller networks may be at a disadvantage to larger networks who may seek to exploit the advantages that network externalities yield to larger incumbents.

Therefore, an analysis of the cost structure indicates that there are significant scale and scope economies that can be exploited through vertical integration.

2. Transaction costs: metering costs, yes (?)

One of the justifications for not employing usage-sensitive pricing in the Internet today is because of the costs of metering traffic. This includes both creating the appropriate infrastructure (*i.e.*, modifying existing routers and servers) and the administrative overhead to meter traffic.

3. Coordination and control: co-specialized assets, yes (?)

The local access network and wide area transport facilities may be regarded as co-specialized assets in the sense that demand forecasting and management, capacity

[30] Technological advances have been reducing network costs in absolute terms and have facilitated the development of more scalable and modular technologies that reduces the effects of increasing returns to scale.

[31] A large network may choose to deny interconnection or offer interconnection at higher prices or of inferior quality to a smaller network in order to lessen the competitive threat posed by the smaller network. Because of the importance of network externalities, manipulation of interconnection policies to exploit, protect, or enhance the market power of a dominant incumbent will remain an important concern for pro-competitive regulatory authorities.

[32] Currently, large backbone carriers exchange traffic using "bill and keep" arrangements. These presume that the costs of termination are minimal or that traffic is balanced. This raises the interesting question of who should be allowed to peer with who, which is ultimately a question of what smaller networks should pay for universal termination services. Currently, a number of large backbone carriers refuse to peer with smaller networks and charge those networks capacity and usage sensitive interconnection fees for transport services.

planning, and network management may be easier for end-to-end services if the underlying facilities are controlled end-to-end.

The importance of this motivation for integrated ownership of facilities is less important today than it was before the development of Equal Access capabilities in the telephone network and the development of open interface standards. The reliance of the Internet on open interface standards makes this rationale for integrating network facilities end-to-end less important than it was before divestiture of the Bell System.

An important driver for end-to-end integration, however, may be associated with the need to provide integrated, quality-of-service differentiated services. This may provide a powerful incentive for an IAP to integrate into ISP services in order to assure reliability, customer security, and to support quality-of-service guarantees for Internet services. An IAP which does not have end-to-end control over Internet services may be constrained in the sorts of services it can offer. This motivation for integration is logically separable from the motivation to integrate facilities end-to-end, or for an Internet service provider to own its own facilities.

4. Product differentiation or price discrimination: sunk costs, yes

The need to recover the sunk and fixed costs of constructing network facilities will provide a powerful inducement for facilities-based providers to integrate forward to permit product differentiation and price discrimination to offer value-added services.

Because there is likely to be excess capacity and because short-run incremental costs are significantly less than long-run average costs (which include fixed and shared costs), it will be difficult for facilities-based providers to avoid aggressive "Bertrand-like" price competition. This argument is explained at greater length in Srinagesh and Gong (1996).

In order to price discriminate, facilities-based providers will have a strong incentive to offer bundled services (*i.e.,* one-stop shopping and services that bundle transport with value-added features such as enhanced billing, new features, etc.). Creative bundling will facilitate a wider range of targeted discount programs that can be used to more narrowly target customer groups. Moreover, one-stop shopping bundles offer opportunities to offer forward-discounts (*i.e.,* rebates to customers who stay with you, or volume discounts over multiple services) that reduce customer's incentives to switch to a competing carrier.

While this will provide an extremely powerful motivation for facilities-based providers to integrate downstream into services, it will not preclude the existence of non-facilities based service providers, as I will discuss further below.

5. Innovation and strategic positioning: ??yes

In technologically advanced markets, the need to vertically integrate to fill a new opportunity (no current supplier upstream, no distribution channel downstream) is often

an important motivation. Similarly, vertical integration may be needed to develop complementary skills.

It seems less likely to be important for integration of local and wide area facilities providers, because these services already exist and the skills associated with each are not substantially different. However, this may provide a motivation for IAP-ISP integration or for facilities integration into IAP or ISP services. In both cases, integration may result in an expansion of firm-specific skills. Moreover, IAP-ISP integration may be required to offer quality-differentiated services as noted above.

6. Market power: probably, but won't discuss

As noted above, vertical integration is often pursued or considered as a strategy to protect, exploit, or extend market power. Because this is harmful to competition, antitrust policy scrutinizes the effects of vertical mergers for their effect on competition.

Although this is an important motivation, discussion of its impact is beyond the scope of this paper.

B. Viability of wholesale market for IP bearer service

The existence of non-facilities-based providers requires the existence of a wholesale market for an IP bearer service. I am assuming that there will be an IP bearer service as suggested in the Open Data Network (ODN) model described in the National Research Council (1984) report. According to this model, multiple technologies will be able to support an enhanced version of IP services flexibly and interoperably across a wide array of applications at higher protocol levels.

As noted above and discussed in Srinagesh and Gong (1996), facilities-based providers will have a powerful incentive to integrate forward into product services in order to differentiate their products and price discriminate. Kavassalis, Lee and Bailey (1997) argue that such differentiation will be possible even at the facilities-level because of differences in the ability of applications to support the full spectrum of applications. They argue that the bearer service market will not be a commodity market, and hence, will support multiple types of organizational structures. The analysis presented here complements their work and reaches a substantially similar conclusion.

Moreover, even if Kavassalis, Lee and Bailey (1997) are incorrect in arguing that bearer-services will be differentiated, it is likely that there will exist a wholesale bearer service market. Such a market already exists in long distance telephone services. The factors which will contribute to the existence of such a market are as follows:

- **Excess capacity**: as argued above, there are fundamental cost and demand drivers that will result in excess capacity. This will include capacity that was installed for future growth (*e.g.,* dark fiber) as well as capacity on different

vintage networks.[33] Moreover, competition will imply churn and excess capacity inventory to accommodate uncertainty in market shares.

- **Free-rider problem of disciplining competition**: unless facilities-provisioning is a natural monopoly, there will be multiple facilities providers from which potential non-facilities-based resellers can lease capacity. Even if reseller competition harms facilities-based providers as a whole, it will be difficult for them to collude on an anticompetitive strategy to resist competition (it will always be privately profitable to defect from the high "bearer service" price strategy to capture reseller business at the margin).[34]
- **Open interface standards and architecture of the Internet**: because IP can run on many technologies and can be used to flexibly interconnect heterogeneous networks, it will be relatively easy for competing facilities based on competing transport technologies (*e.g.,* ethernet, frame-relay, ATM, etc.) to support competing versions of an IP bearer service.

It is likely that bearer services will be available under a variety of terms and conditions. These will range from relatively short term contracts (approaching spot markets for wide area transport) to longer-term capacity commitment contracts. These latter sorts of contracts may approach full vertical integration as the reseller assumes a greater proportion of the capital risks and residual control rights associated with the underlying capacity.

C. Integration downstream more likely than upstream

As noted above, the incentives to vertically integrate are strongest for the facilities-based providers. Moreover, the economic barriers to entry are greater for upstream integration.[35] Therefore, it is more likely that upstream firms will integrate downstream (*i.e.,* ISP into IAP, LAT into IAP, WAT into ISP, and LAT into WAT -- rather than the reverse).

D. ISPs will integrate into IAP services

National IAP's are likely to have important advantages in a number of markets, and it seems unlikely that a national ISP would not seek to exploit this opportunity by offering retail-level services. As discussed above, therefore, it is expected that most ISPs will also offer IAP services. A standalone ISP seems unlikely in the future because

[33] If customers switch to cable modems, the copper plant in the ground will become available for other uses.

[34] Facilities-based providers could deter reseller competition by colluding to set the wholesale price for bearer services too high. First, such a strategy would be violate antitrust law. Second, while such a strategy may be collectively profitable, it would be privately rational for an individual facilities-provider to defect and offer wholesale bearer services to resellers.

[35] In order of increasing entry barriers, the markets may be ordered by: IAP, ISP, WAT, LAT. Facilities-based entry is more capital intensive and LAT entry is the most capital intensive. Moreover, the LAT market is relatively small for the capital investment so is most likely to exhibit natural monopoly characteristics.

it would compete as a wholesaler and would be at a disadvantage relative to a facilities-based reseller.

There will continue to be a competitive fringe of standalone IAPs because entry costs are quite low as long as there is a viable resale market for IP bearer services offered either by IAP-ISP facilities and non-facilities based carriers. These IAPs will be both pure resellers (reselling bulk services purchased from other IAP-ISPs) or facilities-based resellers that lease the capacity from LATs. These service providers will continue to survive because of their strategic advantage in providing retail-level services to niche customer groups, but are not expected to earn excess profits. Examples of niche opportunities include vanity credit cards, "mom and pop" operations, etc. A potentially rich source of such firms are firms that have local access capacity installed for another reason that can be expanded to support IAP at a low incremental cost. This may include Shared Tenant Services networks in apartment buildings or malls that could be extended to offer IAP services to the surrounding community, or even perhaps, private intranets.

E. Facilities-based providers will integrate into internet services

LAT entry into IAP or WAT entry into ISP would involve a relatively small incremental cost, especially because these providers are already providing retail-level services to consumers. Adding internet level services would provide them another opportunity to offer "one-stop" shopping and to respond to competition from ITel. In the near term, entry by a LAT into IAP may be limited by regulatory considerations.[36]

LAT entry into WAT faces significantly lower economic entry barriers than does reverse both because LAT entry is more capital intensive.

[36] Were the RBOCs to suddenly become the dominant internet access providers, squeezing out existing IAPs, regulatory authorities may be moved to impose additional regulatory restraints. Similarly, cable TV providers may be reticent to provide telephone service competition (if ITel takes off) for fear of becoming subject to telephone regulation (*e.g.,* subject to equal access provisions, required to contribute to universal service, etc.).

Table 1
National ISPs in the United States
(Source: CIX membership, listed as national network)[37]

Carrier	Carrier
@home Network	Global One
ANS CO+RE Systems, Inc.	Global Village Communications
Apex Global Info Systems(AGIS)	GoodNet
Ascend Communications	IBM Global Network (Advantis)
Ashton Communications	ICon International
AT&T	LDS-iAmerica
BBN Planet	MCI
Cable & Wireless, Inc.	NETCOM
CRL	PSINet
Data Research Associates	Qwest Communications
DIGEX (Digital Express Group)	Sprint
Digital Equipment Corporation	TheOnRamp Group, Inc.
DirectNet Corporation	ThoughtPort
Fibernet	UUNET Technologies, Inc.
Genuity Inc.	VBCnet (GB) Ltd
GetNet	Verio

[37] See http://www.cix.org. As of January 1998, the website listed 146 members. Of those, 32 are described as having national (or international) networks.

Table 2
Telecommunications Carriers in the United States
(Facilities based carriers)[38]

Carrier Type	Number in 1996
Competitive Access Providers (CAPs) and Competitive LECs (CLECs)	109
Interexchange Carriers (IXCs)	143
Local Exchange Carriers (LECs)	1,371
Total	1,623

Major Telecommunication Carriers in United States

Company	Carrier Type	Operating Revenues[39] ($billion 1996)
AT&T	IXC	39.3
MCI	IXC	16.4
Worldcom (formerly LDDS)	IXC	4.5
Sprint	IXC and LEC	10.8
GTE	IXC and LEC	12.6
Ameritech	LEC	11.3
Bell Atlantic (merged with Nynex)	LEC	25.2
BellSouth	LEC	14.4
SBC (merged with PacTel)	LEC	18.0
US WEST	LEC	9.8

[38] Source: Table 8.17 in the *Statistics of Communications Communications Common Carriers 1996/1997*, Federal Communications Commission, Washington, DC, December 1997. These are counts for the number of carriers which pay into the telecommunications relay service fund.

[39] Source: Table 1.2 in the *Statistics of Communications Communications Common Carriers 1996/1997*, Federal Communications Commission, Washington, DC, December 1997.

Table 3
Sample of Significant Communication Company Restructuring

Date	Event
1997	Bell Atlantic acquired Nynex
1997	SBC acquired PacTel
1997-1998	British Telecom tried to acquire MCI, GTE bid for MCI, Worldcom tries to acquire MCI
1997	AT&T tries to merge with SBC, AT&T tries to acquire Teleport
1996	Worldcom acquires MFS and UUNET
1997	Worldcom acquires Compuserve, divests retail business to AOL in return for AOL network and service contract
???	@home network started by TCI
???	Qwest founded
1997	GTE acquires BBN
???	???

Need to complete table and check dates.

Table 4
Potential Firm Types

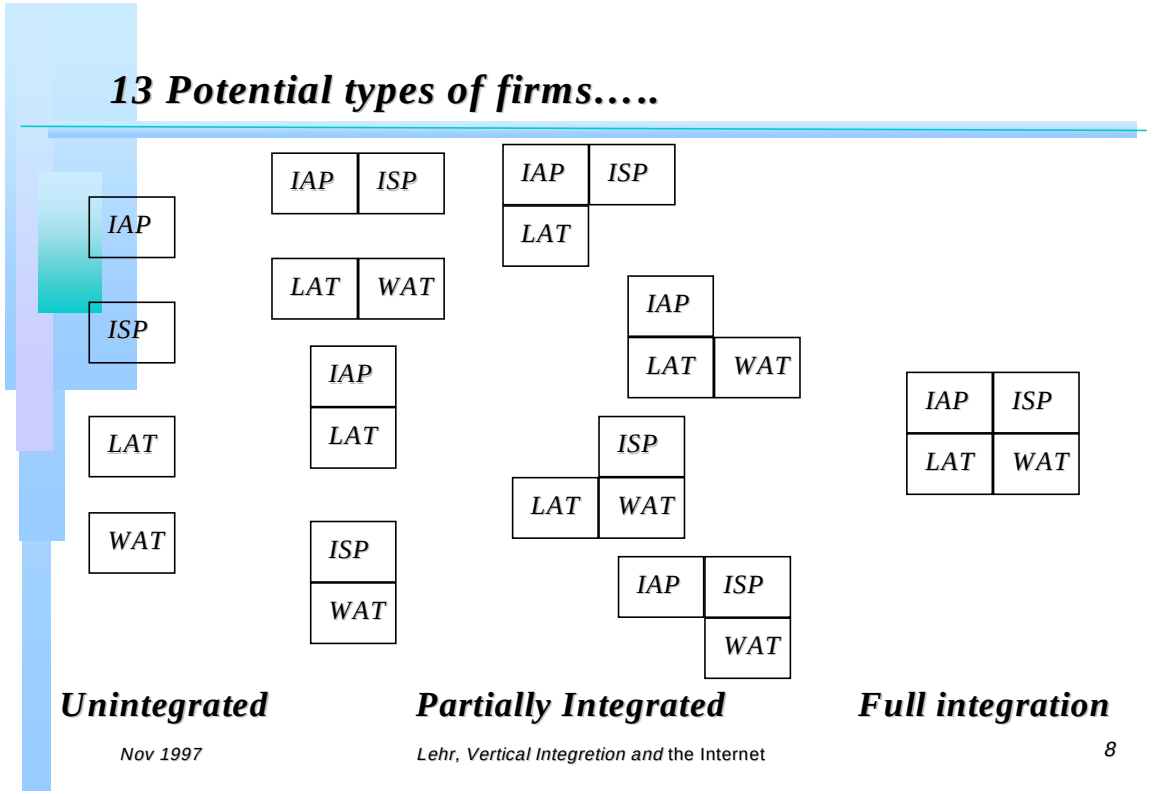

Table 5a: Internet Industry Structure -- Market Interfaces

Interface	Buyer	Seller	Market/Good Purchased	Comment
1	Customer	Internet Access Provider (IAP)	Internet access and web hosting service for small businesses and residential customers. Could be transaction or monthly purchase.	Pricing interface between final demand and supplier value chain. This is source of all revenue which flows into the network. Note, this is logical interface because possible to imagine separate contractual arrangements with each of the providers in value chain.
2	Internet Access Provider (IAP)	Internet Service Provider (ISP)	Bilateral interconnection agreements to provide wide area internet transport and universal termination	Retail-Wholesale relationship, where IAP provides all customer interface functions and ISP provides wide area transport and ubiquitous connectivity. Potential for vertical integration.
3	Internet Service Provider (ISP)	Internet Service Provider (ISP)	Interexchange points and bilateral interconnection agreements to provide wide area internet transport and universal termination.	Wholesale-wholesale relationship between peer ISPs. Potential for horizontal integration to expand scope of service.
4	Internet Access Provider (IAP)	Local Area Transport (LAT)	Regular tariffed business line service from LEC for dial-up access and leased lines to ISP POP	Pricing interface for essential input for IAP to provide service. Today, ISP typically leases local access facilities from regulated monopoly LEC. Potential for vertical integration.
5	Internet Service Provider (ISP)	Wide Area Transport (WAT)	Leased lines and VPN services purchased in wholesale toll market for wide area transport	Pricing interface for essential input for ISP

Table 5b: Examples of Internet Industry Market Interface Transactions

Interface	Buyer example	Seller example	Market/Good Purchased	Comment
1	Residential consumer	TIAC, Barnet	$20/month unlimited usage for dial-in Internet access. Implicitly, this is end-to-end service for Internet applications.	Customer purchases flat rate local telephone service and uses 28.8 modem to access IAP over local dial-up call.
2	TIAC, Barnet	MCI	DS-1 or DS-3 interconnection.	Capacity-based pricing for interconnection, may include traffic sensitive component. This is hierarchical relationship.
3	MCI	UUNET	DS-1 or DS-3 interconnection.	Revenue neutral peering relationship.
4	TIAC	Nynex	Regular tariffed business line service from LEC for dial-up access and leased lines to ISP POP	IAP avoids paying access charges for traffic.
5	MCI, UUNET	MCI, AT&T	Leased lines and VPN services purchased in wholesale toll market for wide area transport	Bulk transport services purchased in competitive wholesale market for $0.01-$0.03 per minute.

Table 6a: Internet Industry Structure -- Participant Characteristics

	Characteristics
Customer	• residential subscriber (commercial customers much more complex because they have many more options to self-provision and contract at different stages in value chain). • buyer of internet access services and CPE. • inherently local. • very heterogeneous willingness-to-pay. Many subscribers. Diverse QoS requirements and tolerance for congestion. • often risk averse so prefer flat rate pricing. Demand is multi-dimensional, defined over multiple aplpications (WEB, telephony, email, etc.). • no market power. Each small relative to market. Demand's are not coordinated. • demand of individual customer is very bursty and hard to predict, but application demand in aggregate may be relatively easy to predict depending on application.
IAP	• sell Internet access services to residential subscribers and buy network equipment, local transport services, and ISP services. • inherently local, although may be active in multiple local markets. • diverse size ranges from quite small to large. Large are typically vertically integrated with ISP to provide national access and possibility of improved congestion control (e.g., by segreting traffic).
ISP	• sell Internet backbone/termination services to IAPs and buy network equipment, wide area transport services, and backbone/termination services from other ISPs. • inherently regional or national. May be integrated forward into IAP services. • medium to large size ranging from regional to global backbone providers. In most cases, single interconnection between ISPs is sufficient to connect source and destination. • offer transport and universal termination services to enable IAP to sell end-to-end access to final consumer.
LAT	• sell local area access, termination and transport services to IAPs. • inherently local. • Large regional RBOCs, currently seeking to expand into interLATA service.
WAT	• sell wide are transport services to ISPs. • inherently regional, national or global. • large national IXCs, currently seeking to expand into local access service.

Table 6b: Internet Industry Structure -- Costs

Participant	Costs
Customer	• Customer: zero incremental cost for usage under current regime beyond opportunity cost of user's time. Significant adjustment costs to change interface (learn, purchase new CPE). Potential for large congestion costs in aggregate. • Largest usage sensitive cost is opportunity cost of consumer's time (and negative impact of congestion.) Fixed cost small, sunk cost may be significant (first-mover advantage).
IAP	• IAP: retailer cost structure. Operating expenses include corporate overhead, sales & marketing, customer service, and telco and ISP service fees for transport. Capital equipment includes modem banks and servers. • most costs variable with customer count, including capital costs which scale with modems. Modem costs vary with usage, but retail-level costs are not usage sensitive.
ISP	• ISP: wholesaler cost structure. Operating expenses include corporate overhead, network operations (maintenance), and telco service fees for leased lines. Capital equipment includes routers, gateways and backbone transport facilities. Network operations and maintenance. • Capital costs vary with capacity, but not usage. Large share of costs are sunk or fixed. Potential for significant variable costs if usage-sensitive termination fees charged for settlements. • Gateways and shared transport, e.g., international undersea cable plant when ISP-ISP interface which need to be recovered.
LAT	• LAT: cost structure of RBOC. Operating expenses include corporate overhead, retail-level costs, and network operations. Capital costs include local distribution plant and switches, but former dominate. • Large fixed and sunk costs. A significant share of costs is NTS and customer-specific. Large scale economies and expectation that no more than a few facilities-based carriers in any locale.
WAT	• WAT: cost structure of IXC. Operating expenses include corporate overhead, retail-level costs, network operations, and local access charges. Capital costs include POPs, switches, and long haul transport facilities. • Large fixed and sunk costs, however, much less capital intensive than RBOC. Large scale economies. Retail-level costs more significant because of increased competition (includes customer churn). Inherently national.

Table 7: Vertical Integration and Industry Structure

Type of Firm	Today?	Future?
IAP	Yes, low entry costs. Small (e.g., TIAC)	Yes. Small in future. Large are national.
ISP	No. If ISP, then also IAP.	No (?? maybe if sufficient market of standalone IAPs. Could avoid retail-level costs).
LAT	Yes, regulation and economic entry barriers (e.g., RBOCs -- Bell Atlantic)	No. Incentives to integrate forward.
WAT	Yes, regulation and low entry costs because of active reseller market (e.g. AT&T)	No. Incentives to integrate forward.
IAP-ISP	Yes (e.g., UUNET, AOL)	Yes, taking advantage of wholesale bearer service market.
LAT-WAT	No (exceptions GTE, International)	Yes (??), because of Telco Act and technology
IAP LAT	No, regulation.	Yes(??)
ISP WAT	No. If ISP then also IAP.	Yes(??). If WAT then why not ISP.
ISP LAT-WAT	No	No(??). If ISP then why not IAP also.
IAP LAT-WAT	No	No. If WAT and IAP then why not ISP also.
IAP –ISP WAT	Yes (e.g., MCI)	Yes(??)
IAP-ISP LAT	No	Yes(??)
IAP –ISP LAT-WAT	No (but GTE, international yes)	Yes

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