Consumer Federation of America

THE PUBLIC INTEREST IN OPEN COMMUNICATIONS NETWORKS

Mark Cooper

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Consumer Federation of America

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I. SUMMARY

For almost two decades, consumer advocates have been among the leading proponents of open communications networks. Unlike most consumer issues, where price is the advocates' central concern, in the matter of communications and the Internet, their primary focus has been on another aspect of market performance: innovation. They view open communications networks as an environment friendly to innovation driven by consumer choice and decentralized decision-making. Their analyses have demonstrated the benefits of open communications networks in terms of core Internet services, computer development, and broad spillovers into the economy.

This Issue Brief summarizes the public interest in open communications networks by providing an analytic framework for evaluating the impact of open communications. It applies the framework to two critical public policy issues currently being considered by the Federal Communications Commission (FCC or the Commission) and the courts – nondiscriminatory access to telecommunications networks and oversight of services delivered by Internet protocols (IP-enabled services).

A CRITICAL POLICY DECISION

In the last quarter of the twentieth century, the convergence of computers, communications, and the Internet, all deployed under design principles of open architecture, created a digital communications platform that became a uniquely important platform or "bearer service." It supports a broad range of economic activities in the 21st century digital economy and revolutionized the environment for innovation. Nations, regions, industries, and firms that seized the opportunity presented by the open digital communications platform have enjoyed much more vigorous economic growth than those that did not.

Policy choices that required open architecture and nondiscrimination in access to communications networks played a key role in creating the open communications environment. For three decades the Computer Inquiries of the FCC required open architecture and nondiscrimination in access to communications networks and kept the underlying telecommunications facilities open and available, ensuring that services could grow without the threat of foreclosure or manipulation by network operators. This constrained the ability of telephone companies to leverage control over the communications infrastructure and ensured a network that was interconnected and accessible to producers and consumers, free from the domination of centralized network operators and not Balkanized by proprietary standards. Open communications networks mirrored and supported the open architecture of the Internet.

After decades of success, policymakers in the U.S. seem to have lost their appreciation for the fundamental importance of the principle of open architecture. Federal regulators have accepted the proposition that the owners of advanced telecommunications facilities should no longer be obligated to provide non-discriminatory access to their networks. Fortunately, although the FCC has repeatedly tried to eliminate the obligations of nondiscrimination in interconnection and carriage, the fundamental policy decisions are still up in the air. Appeals courts have declared twice that principles of nondiscrimination should apply to advanced telecommunications networks. Many regulatory proceedings that will define the architecture of the communications network in the 21st century are ongoing at the FCC or in various stages of litigation.

Thus, the principle of open architecture in communications networks is still in play. A deeper appreciation of its importance remains vital in the policy debate. This paper argues that allowing network owners to discriminate against communications, content, equipment, or applications represents a dramatic change that would render the information environment much less conducive to innovation. The mere threat of discrimination dramatically affects incentives and *imposes a burden on innovation today*.

The case is made for open communications networks by combining two analytic frameworks. The first perspective is provided by the new field of network theory, which pinpoints the source of the benefits of open communications. The second perspective is provided by analysis of network economics. It highlights the positive aspects of network effects and feedback loops. Concerns about network effects that may enhance the market power and anticompetitive behavior of firms dominating critical locations in the platform also need to be raised. By describing the underlying network principles that created the conditions for a technological revolution, the paper endeavor to highlight critical policy decisions that helped to create and sustain the dynamic innovation environment in the narrowband past, which should be embraced for the broadband future.

OPEN COMMUNICATIONS AND THE DIGITAL INFORMATION REVOLUTION

The digital communications platform consists of four layers: the physical layer, the code layer, the applications layer, and the content layer. At the physical layer, cheap, powerful computers, routers, switches, and high-capacity fiber optic cable are the rapidly proliferating physical infrastructure of the digital economy that allows communications at rising speeds with falling costs. In the code and applications layer, a software revolution is the nervous system that enables messages to be routed, translated, and coordinated. Open protocols facilitate communications. Standardized and pre-installed bundles of software applications have allowed the rapidly expanding capabilities of computer hardware to become accessible and useful to consumers with little expertise in computing. At the content layer, every sound, symbol, and image now can be digitized. As computing speeds, storage capacity, and transmission rates become big enough, fast enough, and cheap enough, it becomes feasible to move huge quantities of voice, data, and video over vast distances.

The technological changes had dramatic economic effects. Supply-side, economies of scale and scope drove costs down. By increasing the number of units and types of services sold, the cost per unit falls dramatically. Demand side economies of scale, known as network effects, are an equal, if not more powerful, source of cost reductions. As more consumers use a particular technology, each individual consumer can derive greater benefit from it. In addition to the direct network effects (direct communications between end-users on the network), larger numbers of users seeking specialized applications create a larger library of applications that become available to other users. As the installed base of hardware and software deployed grows, learning and training can be applied by more users and to more uses.

The nature of information reinforces the technological and economic changes. Information production exhibits unique characteristics. It is significantly non-excludable. Once information is distributed, it is difficult to prevent it from being shared by users. It is non-rivalrous. The consumption of information (reading or viewing) by one person does not detract from the ability of others to derive value from consuming it. It exhibits positive externalities. Information is a major input to its own output, which creates a feedback effect. Putting information into the world enables subsequent production at a lower cost by its original producers or others. Where network effects and feedbacks are direct and strong, they create positive feedback loops.

The effect of the digital platform was driven by the fact that the three major components of the digital platform – the personal computer, the Internet, and telecommunications networks – had open architectures for key interfaces. The architectural interfaces to access the components were available to all potential users and producers on identical terms and conditions. Users did not have to negotiate rates, terms, and conditions or request permission to deploy or interconnect new components or services. Individuals seeking to plug into or develop a component or application for the platform could not be discriminated against. They simply had to conform to an open standard.

Decentralized experimentation by users turned them into producers whose command over increasing computing power created the conditions for a dramatic increase in innovation. The Internet unleashed competitive processes and innovation exhibiting the fundamental characteristics of audacious or atomistic competition. Open communications networks played a key role by allowing experimentation, innovation and commercial activity to flourish rapidly across a broad national and international scope.

A strong commitment to open architecture was critical to ensuring the platform was open. A longer historical perspective on the role of open communications networks in the development of capitalist economies suggests that increasingly interconnected and open communications networks have played an important part in furthering economic growth.

The legal obligations of common carriage and nondiscrimination, ensuring open access to the highways of commerce and means of communications, dates back to the end of feudalism and emergence of capitalism. They have been applied in increasingly sophisticated forms of commerce and communications, from early inns to roads and highways, canals, railroads, the mail, telegraph, and telephone. The FCC's Computer Inquiries were the information age embodiment of these principles.

The commitment to open architecture in public policy went farther. The Internet protocols themselves were the result of a search for a more robust architecture for communications. Having initiated the Internet project based on principles of open architecture, the government's insistence that open protocols be supported, as the Internet moved toward widespread availability, was also an important policy decision.

ROBUST NETWORKS AND TECHNOLOGICAL CHANGE

Emerging network theory helps to explain the fundamental institutional underpinning of the dramatic technological and economic developments associated with the open digital communications platform. Across a range of physical and social sciences, this theory offers a policy-relevant explanation of robust (successful) institutions based on an understanding of the principles of network architecture. The architecture of the network dictates its robustness. Open architecture is a key to multiscale connectivity, the central architectural feature of "ultrarobust" networks. This is also the fundamental characteristic of the digital communications platform that is critical to the new information environment.

Interconnectivity is a critical feature of networks. Robust networks are typified by the formation of links between nodes, with hubs forming bridges that hold the network together. In robust networks, hubs and links form modules. Modules share strong internal ties and specialize in discrete functions, but have weak ties to the rest of the network through bridges. Successful networks grow and establish structures according to rules that foster efficient communications structures. The efficient, robust networks are hierarchical and modular; exhibiting both decentralized and distributed communications traits. This allows experimentation at the periphery, without threatening the functionality of the network. Failure is not catastrophic, since it can be isolated and its impact minimized. Success can be pursued independently because of modularity and exploited quickly because of efficient communications.

Robust networks support rapid and efficient technological innovation. Efficiency in decision-making occurs by breaking down problems and solving them at the "local" level, because local information is the ultimate source of the solution, but local clusters must be modules, possessing adequate resources and autonomy to solve problems. The result is efficient as long as it economizes on the need to flow information up through the hierarchy. Modularity with open interfaces loosens the dependence on simultaneous solutions to multiple problems by supporting implementation at different places and different rates. The digital communications platform exhibits these characteristics in the extreme. It is modular, hierarchical, and distributed. It exhibits dense, multiscale connectivity. It has the characteristics of an ultrarobust network.

The digital communications platform has transformed the very fabric of the innovation process. The open digital communications platform facilitates and accelerates technological innovation by altering the information environment to make distributed solutions more feasible. The digital communications platform became a critical enabling technology, in which interconnection, interoperability, and maximization of available functionality to end-users are essential ingredients for the continued flow of dynamic innovation. The digital revolution allows technical knowledge to be embodied in software and hardware and to be implemented and coordinated with rapid communications over great distances.

Technological innovation has moved outside the firm. As hierarchical modularity in the network replaces vertically integrated hierarchy in the firm, complex digital platform industries have benefited from open network approaches. Smaller innovative firms each pursuing a particular challenge results in greater innovation and technological change. Vertical integration and extreme hierarchical structure lose their comparative advantage; modular flexibility and connectivity gain significant advantage.

The revolution in communications and computing technology combines with the institutional innovation of the Internet to create not only a potentially profound change in the environment in which information is produced and distributed, but it opens the door to greater competition among a much wider set of producers and a more diverse set of institutions. The deeper and more pervasively the principle of openness is embedded in the communications network, the greater the ability of information production to stimulate innovation.

Given the characteristics of the digital communication platform, public policy should favor open interfaces in the platform because of the strong complementarities across a large number of components. Coordination and collective action problems make it difficult to coordinate progress through private transactions. Private interests with strategic assets can "hold up" the advancement of the platform. Open interfaces overcome these problems. In each of the components of the platform, repeated efforts to impose proprietary closure were challenged and rejected. In the telecommunications network and the Internet, public policy resisted closure.

THREATS TO OPEN COMMUNICATIONS NETWORKS

A framework for economic analysis of the digital communications platform must also recognize the potential for new and more harmful types of anticompetitive behavior in platform industries. Platforms heightened the potential for negative, anticompetitive actions by private parties who have a dominant position at key locations of the platform. This also provides the basis for policies to defend the open architecture of the platform. Dominant firms that own and control key layers of the platform may have the incentive and ability to protect and promote their interests, distorting the architecture of the platform at the expense of competition and slowing innovation.

In old economy industries, vertical leverage is exploited by business practices. By integrating across stages of production, incumbents can gain control over critical inputs, which can be withdrawn from the open market, driving up competitors' costs. This vertical integration creates barriers to entry by forcing potential competitors to enter at more than one stage, making competition much less likely. Exclusive and preferential deals for the use of facilities and products compound the problem. Vertical integration facilitates price squeezes and enhances price discrimination.

In a platform industry, vertical leverage can take an additional and more insidious form, technological manipulation. Introduction of incompatibilities can impair or undermine the function of disfavored complements. The refusal to interoperate or the withholding of functionalities is an extremely powerful tool for excluding or undermining rivals and thereby short circuiting competition.

The growing concern about digital information platform industries derives from the fact that the physical and code layers do not appear to be very competitive. There are not now, nor are there likely to be, a sufficient number of networks deployed in any given area to sustain vigorous competition. Vigorous and balanced competition between operating systems has not been sustained for long periods of time.

Dominant firms at the physical and code layers have a variety of tools to create economic and entry barriers such as exclusive deals, retaliation, manipulation of standards, and strategies that freeze customers. They can leverage their access to customers to reinforce their market dominance by creating ever-larger bundles of complementary assets. Control over the product cycle can impose immense costs by creating incompatibilities, forcing upgrades, and by spreading the cost increases across layers of the platform to extract consumer surplus. If a firm is a large buyer of content or applications or can dictate which content reaches the public through control of a physical or code interface, it can determine the fate of content and applications developers.

These anti-competitive behaviors are attractive to dominant firms in the physical and code layers for static and dynamic reasons: preserving market power in the core market, preventing rivals from achieving economies of scale, enhancing the ability to price discriminate, driving competitors out of neighboring markets to create new market power, and diminishing the pool of potential competitors. The observable behavior of the incumbent wire owners gives immediacy to the concerns that the physical layer of the communications platform will not perform efficiently or in a competitive manner without a check on market power. Public policy should resist efforts to impose proprietary closure, which would undermine the open architecture of the platform.

THE IMPORTANCE OF ISPS IN THE COMMERCIAL SUCCESS OF THE INTERNET

ISPs are the initial hubs on the periphery of the Internet closest to the end-user end-points. ISPs played a critical role in the adoption of Internet services by the public. Moreover, because the focal point of change in the Internet revolution has been at the periphery of the communications network, we should not be surprised to find the most pronounced effect of a change in policy there. Certainly the conflict over open architecture has been centered in a battle between ISPs and network owners.

ISPs were generally small operators who tied together the broader population of users. Buying wholesale telecommunications service from telephone companies and selling basic Internet access, combined with a variety of additional applications and services, to the public, they translated the complex technologies that had to be combined to use the Internet into a mass market service. Some of the underlying innovations that the ISPs adapted and popularized had been around for a while; some were very recent, but there were few plain vanilla ISPs, offering only basic access to the Internet.

Local specificity and the importance of the linking and communications functions of ISPs were critical because adaptation requires meeting the needs of a diverse set of users. Thousands of ISPs tailoring services to customer needs supported the rapid spread of Internet subscription and use, but the impact of these ISPs went beyond merely spurring the adoption of Internet service. They opened markets that were neglected by dominant ISPs and forced dominant firms to make services available that they might well have resisted had they not faced the competition.

The competitive pressures brought by small ISPs, and the investment in complementary communications equipment, stimulated by having nondiscriminatory access to the underlying network, represents a general pattern that can be expected to be repeated. In fact, a similar process can be seen in the development of competitive local exchange carriers (CLECs). These entities began by innovating in marketing and customer service, but they also made substantial contributions to the production side of the industry. They have driven innovation in operating support and back office systems, rights of way and collocation, and the provisioning and use of fiber.

Thus, the introduction of competition in a middle or applications layer not only promotes efficiency in that layer, but it may provide the base for launching competition across layers, as well as stimulating investments in complementary assets. It is this competition that is undermined by the closure of the physical layer as the Internet transitions from the open, dial-up communications network to the closed broadband networks being fostered by current FCC policy.

Cable operators have successfully imposed a number of conditions that create discriminatory network access into consumer service agreements or contracts with service providers or have implemented such conditions in the network. Although telephone companies ostensibly have been required to provide access to their advanced telecommunications networks, they have made life miserable for the independent ISPs and CLECs.

ISPs have identified a range of ways the dominant facility owners impede their ability to compete, beyond outright foreclosure. The proprietary network owners impair the ability of competitors to deliver service by restricting their ability to interconnect efficiently and deploy or utilize key technologies that dictate the quality of service. The facility owner can give affiliated ISPs preferential location and interconnection, refusing to peer with other ISPs or to guarantee quality of service to unaffiliated ISPs. Bundling of competitive and noncompetitive services places competitors at a disadvantage. The price charged for access to the network for unaffiliated ISPs is far above costs and leaves little margin. Consumers pay a price too. The resulting price is too high and dampens adoption.

The results of the closure of advanced telecommunications services are becoming clear. The independent business of buying telecommunications services and selling Internet access service has been all but eliminated from the high-speed Internet market. Throughout the history of the commercial narrowband Internet, the number of service providers was never less than 10 per 100,000 customers. At present, and for most of the commercial history of the industry, there have been 15 or more ISPs per 100,000 subscribers on the open, dial-up Internet. In contrast, there are now fewer than 2 ISPs per 100,000 customers on the high-speed Internet. For cable modem service there is less than 1 Internet service provider per 100,000 customers.

The Internet model has been turned on its head in the closed broadband space. Analysts proclaim critical mass of deployment and wait for the killer application, while they worry about how average users will be induced to adopt services. That was exactly the function of the ISPs, who have been decimated by the denial of access to customers. More importantly, Internet applications did not wait for a subscriber base, they drove demand for subscription. By cutting off access to advanced telecommunications service – the oxygen of the Internet – facility-owners have eliminated competition at the service level. A small number of entities dominating the sale of high-speed Internet access and dictating the nature of its use is the antithesis of the environment in which the narrowband Internet was born and enjoyed such rapid growth. In contrast to the steady flow of innovations and the growth of a large customer service sector that stimulated the adoption of narrowband Internet service by a majority of households, the broadband Internet is a wasteland for innovation.

INTERNET PROTOCOL-ENABLED SERVICES

The definitions of telecommunications and information services in the Telecommunications Act of 1996 fits the four-layered model closely. Telecommunications services are defined by the transmission of data (physical layer) subject to network management capabilities (code layer). Information services are defined by capabilities (applications) and subject to user control (content). The definitions adopted by Congress make it clear that the transmission of data over the telecommunications network on which Internet Protocol (IP)-enabled services rely is a telecommunications service. The plain language of the statute has led the Ninth Circuit to that conclusion twice over the past four years.

In the 1996 Act, Congress made it clear that not every transmission is a telecommunications service and not every application is an information service. The nature of a service is not defined by the technology or the protocols used to manage the network; it is defined by what the service does and how it is offered to the public. Congress rejected the idea that the use of a new technology or the use of a new switching protocol automatically renders a service an information service. In fact, it said quite the opposite.

Under the mantra of deregulation, the FCC has sought to eliminate the public interest obligations of nondiscriminatory interconnection and carriage for the nation's advanced telecommunications networks. By failing to regulate the physical layer, the commission has exposed the vibrant competition and innovation on the Internet to the threat of foreclosure. It has also made it more difficult to deregulate the other layers of the platform.

The fact that the underlying transmission is a telecommunications service does not mean that the application riding on it cannot be a telecommunications service as well. Each of the components must be analyzed separately to determine how to define the service. The Ninth Circuit concluded that a service sold to the public could combine both a telecommunications service for transmission and an information service. It is obvious that a service sold to the public also could combine two telecommunications services. In a converging network, however, lines will be difficult to draw. In the past, the Commission has set out to find indicators of the nature of the service as defined by the nature of the transmission, its management, and function.

Because Congress provided explicit direction that changes in protocols for the purposes of network or service management do not change the definition of the service, the initial attempt of the Commission to deal with these matters relied on the concept of a "net change" in the form of the transmitted message. It used the distinction between the code layer and the applications layer to conclude that a change in the protocol to manage the network does not create an information service. That a transmission begins and ends as a voice call, for example, but is managed by being divided into packets, does not make it an information service. The transmission remains a telecommunications service. Analysis of the relationship to the North American Numbering Plan is also a code level consideration. Reliance on the existing telecommunications addressing protocol is an indicator that the service remains a telecommunications service.

The Commission has examined criteria at the physical layer as well. The issue of whether a physical connection is offered to the public for a fee has played a large role in the cable modem proceeding. Examination of the customer premise equipment (CPE) used is another undertaking. Little or no change in the CPE suggests little change in the service. Similarly, reliance on the public switched network to originate or terminate calls is an area of inquiry. If a transmission never traverses the public switched network, the case that this is not a telecommunications service may be strengthened. The opposite is true as well.

At the applications layer, the question of functionality is central. The heart of the information service definition involves the functions or capabilities that are supplied. Delivery of voice calls in real time is a distinct function. Similarly, in the 911 proceeding, the functionality of providing real-time, two-way communications was a consideration. If a service relies on the public switched network, it is more likely to be a telecommunications service.

At the content layer, the critical issue is the way the end-user interacts with the data. Does the end-user control the content and direction of the transmission? Is there an end-user to end-user connection? How are services marketed to and perceived by consumers (e.g., is the service marketed and does the end-user perceive the service as a substitute for a telecommunications service)? In the 911 proceeding, consumer expectations played a key role.

Having defined an IP-enabled service as a telecommunications service, the Commission does not have to impose regulation. It can forbear from federal regulation. To the extent that the Commission would like to forbear from imposing public interest obligations on specific telecommunications services in specific geographic areas, it must engage in a full and complete proceeding under Section 10 of the 1996 Act. In order to forbear, the Commission must make a series of findings:

> (1) enforcement of such regulations or provisions is not necessary to ensure that the charges, practices, classifications, or regulations by, for or in connection with that telecommunications carrier or telecommunications services are just and reasonable and are not unjustly or unreasonably discriminatory;
>
> (2) enforcement of such regulation or provision is not necessary for the protection of consumers; and
>
> (3) forbearance from applying such provision or regulation is inconsistent with the public interest.

It is noteworthy that the first prong of the forbearance test uses terms from the common carrier language of the Communications Act that seem to target the physical and code layers of the platform. The second prong deals with the applications and content layers.

The Commission cannot forbear regulating voice over Internet protocol (VOIP) services offered by owners of advanced telecommunications network. The advanced telecommunications services provided by telecommunications carriers fail all three prongs of the forbearance test. Unregulated telecommunications service providers will charge rates and impose conditions that are unjust and unreasonably discriminatory. Consumers will be abused and the public interest will not be served.

Whether IP-enabled telecommunications services meet the second and third prongs of the forbearance standard is a matter for analysis. The need for consumer protection regulation arises from the nature of the service provided and the state of the marketplace that provides it (independent of the regulation of the advanced telecommunications service). Necessities tend to receive greater regulatory attention. Sustained and vigorous competition provides the best consumer protection and is the only basis for forbearance.

Presently, both the FCC and the state public utility commissions provide consumer protection through minimal regulation of various aspects of the service transaction. Federal authorities require truth in billing and prohibit slamming. Congress has mandated protection of consumer privacy. State authorities regulate the quality of service and seek to ensure that companies meet minimum financial and managerial standards. The persistence of these regulations reflects the nascent nature of competitive sale of local telephone service and continuing problems in these new markets. Consumer protection regulation reflects market conditions, not the characteristics of individual companies.

There are certain public goods that regulators might well find will not be provided, no matter how competitive the marketplace becomes. E-911 service is such a public good. Allowing optional participation creates a free rider problem that can ultimately undermine the entire service. It robs the public of the protection of a ubiquitous E-911 service. We doubt that the Commission can find that forbearing from E-911 regulation is in the public interest. Access for consumers with disabilities may be a similar public good. Telecommunications service providers may not find it profitable to serve such customers, no matter how competitive the market becomes, yet, in pursuit of universal service, society demands that they be provided services that are "readily achievable."

CONCLUSION

The open architecture of the digital communication platform is powerful, but fragile. Open communication platforms hold a special role in the "new" economy. An open and accessible physical layer is critical to the value creation in the platform because it promotes a dynamic space for economic innovation. The true value in the network arises from the creative exploitation of functionalities at the higher levels of the platform.

Arguments against the obligation of nondiscriminatory interconnection and carriage misread the history and incentives of owners of the physical facilities and they misunderstand the value and role of the digital communications platform. It has the unique characteristic of being both a bearer service that affects the ability of many industries to function, as all transportation and communications technologies do, and a general purpose, cumulative, systemic, enabling technology that alters the fundamental way in which numerous industries conduct their business and create technological progress. It is electricity, the railroads, and the telephone rolled into one.

Current arguments against obligations to provide nondiscriminatory access are inconsistent with centuries of legal practice. Obligations of nondiscrimination (e.g. common carriage) were born with and are part of the DNA of capitalism because they facilitate and expand commerce. Monopoly ownership of the means of communications is not now, and never has been, a necessary legal condition for common carrier status. The existence of intermodal competition in other industries did not eliminate the obligation for nondiscrimination. Public roads competed against privately owned canals, but they both were subject to common carrier obligations. Private railroads competed with canals and roads, and they all were subject to common carrier obligations. Telegraph, wireline telephone, and wireless all are common carriers. As we have layered alternative modes of communications one atop another, each using a different technology, each optimized for a somewhat different form of communications, we still impose the common carrier obligations to ensure access.

The empirical record shows that even oligopolistic competition for a critical infrastructure industry will leave far too much rent and control in the hands of the network owners. After repeated efforts by telecommunications facility owners to assert control over access to the Internet, it is hard to imagine they will willingly adopt an open architecture. The leverage they enjoy in a blocking technology and the interest they have in related product markets disposes them to maximize profits by maximizing proprietary control over the network. In so doing, they can reduce the competitive threat to their core franchise services and gain advantages in new product markets. Facility owners demand a level of vertical control that creates uncertainty about future discrimination, whose mere existence is sufficient to chill innovation.

What is clear, then, is that maintaining an open communications platform for advanced services is in the public interest because only such an obligation can ensure a vibrant, high-speed, next generation of the Internet that will drive innovation, provide a greater flow of information, and have a positive impact on the economy and society. Given the nature and role of networks, policymakers should reconsider and reverse the decision to allow proprietary discrimination to undermine the open architecture of the digital communications platform. The role of regulation should be to ensure that strategically placed actors cannot undermine innovation at any layer of the platform. This is best achieved by mandating that the core infrastructure of the communications platform remain open and accessible to all.

II. OPEN COMMUNICATIONS AND THE DIGITAL INFORMATION REVOLUTION

PUBLIC POLICY AND THE INFORMATION REVOLUTION

In the late 1980s, consumer advocates helped push back efforts by the dominant telephone companies to assert control over the Internet through control of the telecommunications network.[1] The consumer advocates believed that there was a critical choice to be made between a centralized and a decentralized approach to providing information services.[2] They warned that the approach advocated by the communications companies "could set the information age development back by undermining the diversified, innovative process of the current decentralized approach."[3] The characteristics of the decentralized approach that the consumer analyses singled out proved to be the essential characteristics of the Internet:

> Pragmatic: Most of these new, innovative services have close substitutes. Why not give individuals maximum flexibility in the choice of equipment and services allowing them to develop applications at the periphery of the network?
>
> Decentralized: Decentralized decisions will select the most cost-effective technologies for specific applications.
>
> Periphery: Intelligence is more concentrated in homes and businesses and on the premises of service providers who connect their services through a local transmission network.
>
> Applications: Specific applications will be required to be cost effective. There will be successes and failures, but the process of trial and error driven by profit will generate lowest cost and minimize public cost risks of network applications.
>
> Individualized: Costs are more highly individualized, borne by those who develop the applications and those who choose to subscribe to them, either through or around the public network.[4]

The consumer analysis argued that fundamental changes in technology had created the basis for a dynamic information environment.[5] In particular, "the fact that a great deal of the necessary intelligence is currently located on the periphery of the information age network has led to a pragmatic, decentralized pattern of development."[6]

Many participants in the debate over advanced telecommunications services (that underlie high-speed Internet services) have pointed out that for three decades the FCC played a key role in creating the dynamic environment that supported the development of the Internet through policies set in its "Computer Inquiries."[7] In these proceedings, the FCC kept the underlying telecommunications facilities open and available, ensuring that first computer data services, then enhanced services and later information services could grow without the threat of foreclosure or manipulation by network operators. Lawrence Lessig is blunt about the government's role, noting that "[p]hone companies… did not play… games, because they were not allowed to. And they were not allowed to because regulators stopped them."[8] Thus, a determined commitment to open communications networks was critical to the widespread development of the Internet – "The government's activism imposed a principle analogous to [end-to-end] design on the telephone network... By requiring the natural monopoly component at the basic network level to be open to competitors at higher levels, intelligent regulation can minimize the economic disruption caused by that natural monopoly and permit as much competition as industry will allow."[9]

Government activism was also crucial in promoting the spread of the open architecture of the Internet.[10] Not only was a decentralized communications network conceived by an arm of the Defense Department and pushed over the objection of the dominant communications companies, but a requirement that open protocols be used by interconnecting networks as the Internet was rolled out to institutions in civil society led to a deeply embedded open architecture in the Internet.

Telephone companies did not get their way at the start of Internet commercialization. Communications networks remained open and the telephone companies' ability to leverage control over the communications infrastructure remained constrained by public policy. The network was interconnected and accessible to producers and consumers, free from the domination of centralized network operators and not Balkanized by proprietary standards. Decentralized activities and widespread experimentation were encouraged by very few restrictions on use.[11]

What emerged was a digital communications platform comprised of a highly interrelated set of activities in the communications, computer, and information industries. Indeed, technological convergence has blurred the distinction between these activities. In the economics literature, the set of information and communications technologies (ICT) are widely seen as creating not merely a new environment in which information is produced and distributed, but also a revolutionary change in a wide range of economic activities.[12]

After a remarkable decade of commercial success, the open architecture of the Internet was again challenged by the owners of a new telecommunications network – cable operators.[13] Controlling the dominant facilities for advanced telecommunications functionalities, they sought to operate the network on a closed, proprietary basis. Consumer groups were among the first to oppose this effort to abandon the principle of open communications networks:

> Today… [t]here is no bundling of connectivity (telephone service) and content (Internet service). Any Internet service provider can advertise a phone number and be reached by a local phone call. It is that unfettered access that has been the seedbed of Internet creativity. It is that access that is threatened by the closed access model the cable industry is pursuing.

> The central consumer concern is that AT&T [the largest cable operator at the time] is pursuing policies that… will extend the cable model of a closed, proprietary network to broadband Internet services…
>
> The cable TV model, based on private carriage, is quite different. Closed system operators choose who has access. Unaffiliated suppliers of content have no way to sell directly to the public. They must negotiate with the owner of the transmission system who sets the terms and conditions of interconnection and can keep them off their networks.
>
> As a result of these restrictive policies, the offer of commercial services is being retarded and consumers are losing crucial alternatives.
>
> These practices are anticompetitive and will damage the free flow of services on the Internet… The abusive treatment of unaffiliated ISPs that will occur in a market populated with closed systems will undermine the fundamental nature of the Internet.[14]

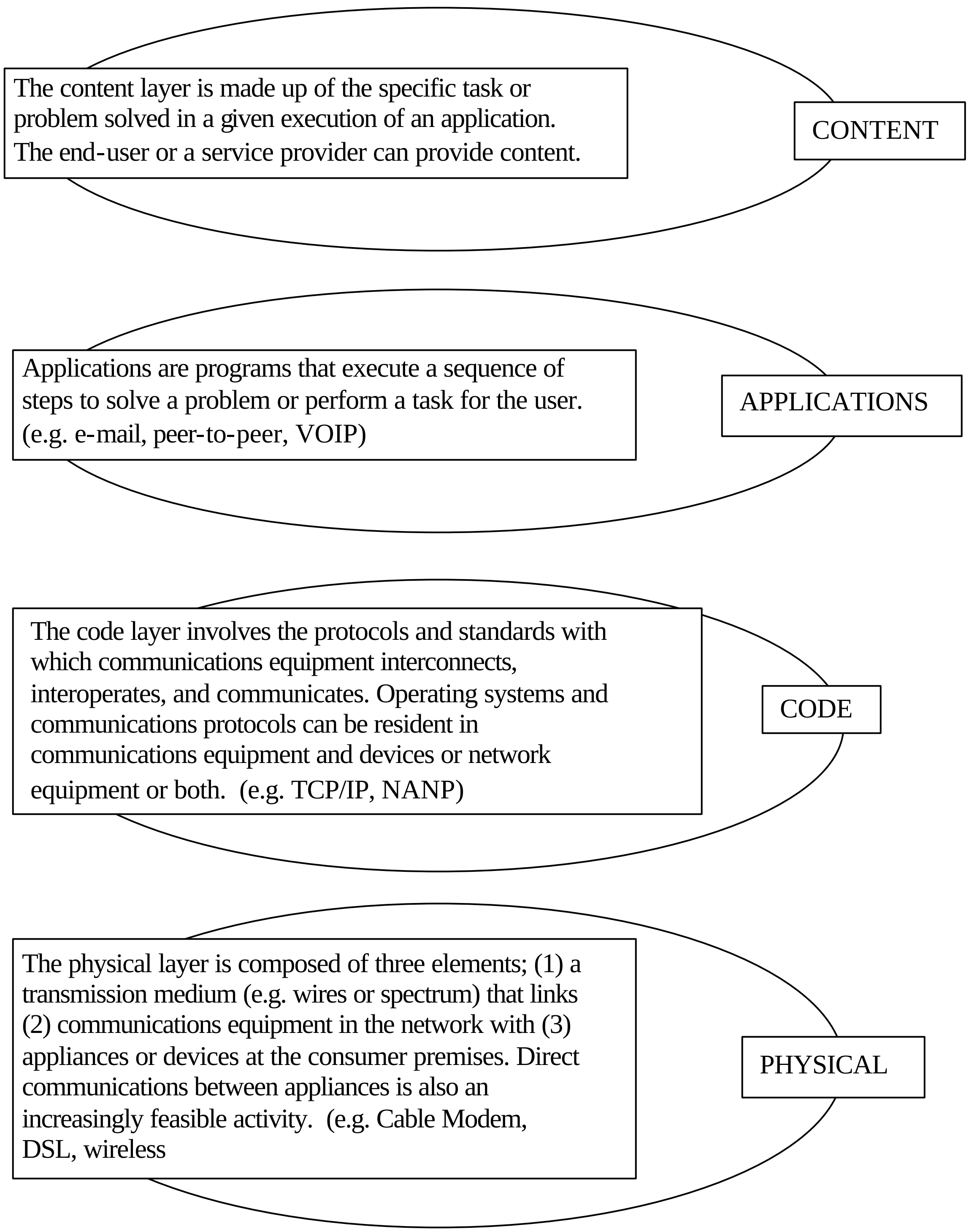
After five years of debate, the FCC officially abandoned its extremely successful policy of requiring open communications networks. It first proposed to allow cable modem service to be closed.[15] It then proposed that telephone companies be allowed to deny access to their advanced telecommunications networks.[16]

The decision about access to the advanced telecommunications networks remains an open, front burner issue, however. Recently, the U.S. Court of Appeals for the Ninth Circuit reaffirmed it original decision to reject the FCC's view of cable modem service.[17] The FCC has not issued a final order in its telephone DSL proceeding. Thus, there is still time to reconsider the fundamental question of open access to the advanced telecommunications network.

THE STRUCTURE OF THE DIGITAL COMMUNICATIONS PLATFORM

To appreciate the dramatic shift that took place in the information environment with the emergence of the digital communications platform, it is helpful to view the platform as consisting of four layers (see Exhibit II-1):[18] the physical layer, the logic or code layer, the applications layer and the content layer. It is a platform because there are strong complementarities between the layers and each layer sustains broad economic activity in the layer above it.[19] Shane Greenstein notes "[a] platform is a common arrangement of components and activities, usually unified by a set of technical standards and procedural norms around which users organize their activities. Platforms have a known interface with respect to particular technologies and are usually 'open' in some sense."[20] The digital communications platform is an important platform because of the special role that communications and information play in the 21st century economy. Moreover, public policy plays an important role because platforms "are typically associated with substantial externalities whose value is difficult to capture."[21]

Exhibit II-1: Layers of the Digital Communications Platform



The physical layer is composed of three elements. It has (1) a transmission medium (e.g., wires or spectrum) that links (2) communications equipment in the network with (3) appliance or display devices at the consumer premises (PC, TV). Direct communications between appliances is also an increasingly feasible activity. The logic (or code) layer involves the codes and standards with which communications equipment and display devices interconnect, interoperate, and communicate. Protocols interpret the signals. Operating systems allocate and coordinate the resources of the system. The operating systems and communications protocols can be resident in communications equipment and devices or network equipment or both. Applications constitute the third layer. Applications are programs that execute a sequence of steps to solve a problem or perform a task for the user (like e-mail or file-sharing). The content layer is made up of the specific task or problem solved in a given execution of an application. The end-user or a service provider can provide content.

The emergence of the digital communications platform altered the relative cost and importance of the factors of information production. The growth of the Internet and its underlying technologies changed the fundamental economics of information production and later the economics of technological change. At the physical layer, cheap, powerful computers, routers, switches and high capacity fiber optic cable are the rapidly proliferating physical infrastructure of the digital economy that allow communications at rising speeds with falling costs.[22] In the code and applications layer, a software revolution is the nervous system that enables messages to be routed, translated, and coordinated.[23] Open protocols facilitate communications. Standardized and pre-installed bundles of software appear to have allowed the rapidly expanding capabilities of computer hardware to become accessible and useful to consumers with little expertise in computing. At the content layer, every sound, symbol, and image can now be digitized.[24] The more complex the sound or image, the more data has to be encoded and decoded to accomplish the digital representation.[25] However, when computing speeds, storage capacity and transmission rates become big enough, fast enough, and cheap enough, it becomes feasible to move huge quantities of voice, data, and video over vast distances.

Communications and computer industries have always exhibited network effects and strong economies of scale.[26] By increasing the number of units sold, the cost per unit falls dramatically.[27] Cost savings may apply not only to initial production costs, but also to service and maintenance costs. Digitization may reinforce these economic characteristics because economies of scope reinforce economies of scale. Adding service to the bundle lowers average costs.

Computer industries exhibit other characteristics. As the installed base of hardware and software deployed grows, learning and training in the dominant technology is more valuable since it can be applied by more users and to more uses.[28] As more consumers use a particular technology, each individual consumer can derive greater benefit from it. In addition to the direct network effects, larger numbers of users seeking specialized applications create a larger library of applications that become available to other users, and secondary markets may be created. These are all the positive benefits of network externalities.

The power of the digital communications platform stems in part from the fact that information production exhibits unique characteristics. It is significantly non-excludable.[29] Once information is distributed, it is difficult to prevent it from being shared by users. It is nonrivalrous.[30] The consumption of information (reading or viewing) by one person does not detract from the ability of others to derive value from consuming it. It has high first copy costs.[31] The cost of distribution is low relative to the cost of producing information. It exhibits positive externalities.[32] Putting information into the world enables subsequent production at lower cost by its original producers or others. In some respects, information is also subject to network effects.[33] The production and distribution of information becomes more valuable as more people gain access to it. Information is a major input to its own output, which creates a feedback effect.[34] Where network effects and feedbacks are direct and strong, they create positive feedback loops.

The effect of the digital platform also was driven by the fact that the three major components of the digital platform – the personal computer (PC), the Internet/Web and the telecommunications network – had open architecture for key interfaces during their initial deployment and commercial success. By open, I mean that the architectural interfaces to access the component were available to all potential users on identical terms and conditions.[35] Users did not have to negotiate rates, terms and conditions or request permission to deploy new components or services. Individuals seeking to plug into or develop an application for the platform could not be discriminated against.

The orders of magnitude of change that underlies the growth in the computer and communications industries are enormous.[36] Since the first desktop computers entered the residential market about thirty years ago, desktop computers have undergone a remarkable transformation. "The cost of processing information and data that once might have been hundreds of thousands, if not millions, of dollars is rapidly falling to zero. The IBM-370-168 mainframe (circa 1975) sold for $3.4 million; today a personal computer with an Intel Pentium chip retails for about $1,500 and is nearly 1,000 times faster."[37] The cost has been cut in half in the two years since this observation was made. Data transmission costs have fallen dramatically as well.

THE BROADER IMPACT

When such a dramatic change takes place in a technology that is critical to a variety of activities, the effects are felt throughout society. Historically, dramatic changes in communications and transportation technology have affected society deeply.[38] The ongoing technological revolution does so as well, but in a uniquely profound way.[39]

Although an obligation to provide nondiscriminatory access to communications networks has been a long-standing principle in the U.S., the most recent iteration of this policy had a particularly powerful effect because it interacted with the spreading technology (computer) and architectural principle of the Internet (end-to-end) to create a uniquely dynamic environment. The digital communications platform "links the logic of numbers to the expressive power and authority of words and images. Internet technology offers new forms for social and economic enterprise, new versatility for business relationships and partnerships, and new scope and efficiency for markets."[40]

The Internet unleashed competitive processes and innovation exhibiting the fundamental characteristics of audacious or atomistic competition.[41] Decentralized experimentation by users who had command over increasing computing power created the conditions for a dramatic increase in innovation.[42] Openness of the communications network was central to this newly dynamic environment.

Because computing intelligence can be distributed widely, and the activities of the endpoints communicated so quickly, interactivity is transformed. "As rapid advances in computation lower the physical capital cost of information production, and as the cost of communications decline, human capital becomes the salient economic good involved in information production."[43] Users become producers as their feedback rapidly influences the evolution of information products.

> It is a proven lesson from the history of technology that users are key producers of the technology, by adapting it to their uses and values, and ultimately transforming the technology itself, as Claude Fischer . . . demonstrated in his history of the telephone. But there is something special in the case of the Internet. New uses of the technology, as well as the actual modifications introduced in the technology, are communicated back to the whole world, in real time. Thus, the timespan between the process of learning by using and producing by using is extraordinarily shortened, with the result that we engage in a process of learning by producing, in a virtuous feedback between the diffusion of technology and its enhancement.[44]

The institutional forms that will expand are those that economize on the most valuable factor of production (now human capital) by facilitating communications to reduce cost or maximize output.[45] Alternatively, the scarcest or most critical input to production becomes the focal point of attention in economic activity.[46] This makes it possible for a wholly new form of information production – based on peer-to-peer relationships – to exist on a sustainable basis.[47] By drawing on a broad and diverse supply of human capital, a loose, collaborative approach can provide a potent mechanism for production.

The impact of this shift in information production is not limited to new organizational forms. Those who have studied corporate changes in the last quarter of the twentieth century have found similar patterns.[48] The new thrust of corporate organization, based on distributed intelligence and a flat structure, reflects these forces.[49] Hierarchy is out; horizontal is in.[50] The ability to coordinate at a distance dramatically alters the nature of centralized control, transferring much decision-making to dispersed management. A Harvard Business School Press publication, graphically titled *Blown to Bits*, summarized the dramatic change compelling corporate adjustment as follows: "Digital networks finally make it possible to blow up the link between rich information and its physical carrier. The Internet stands in the same relation to television as television did to books, and books to stained glass windows.

The traditional link . . . between the economics of information and the economics of things – is broken."[51]

Thus, the revolution in communications and computing technology combined with the institutional innovation of the Internet to create not only a potentially profound change in the environment in which information is produced and distributed, but it opened the door to greater competition among a much wider set of producers and a more diverse set of institutions. We find that the deeper and more pervasively the principle of openness is embedded in the communications network, the greater the ability of information production to stimulate innovation.

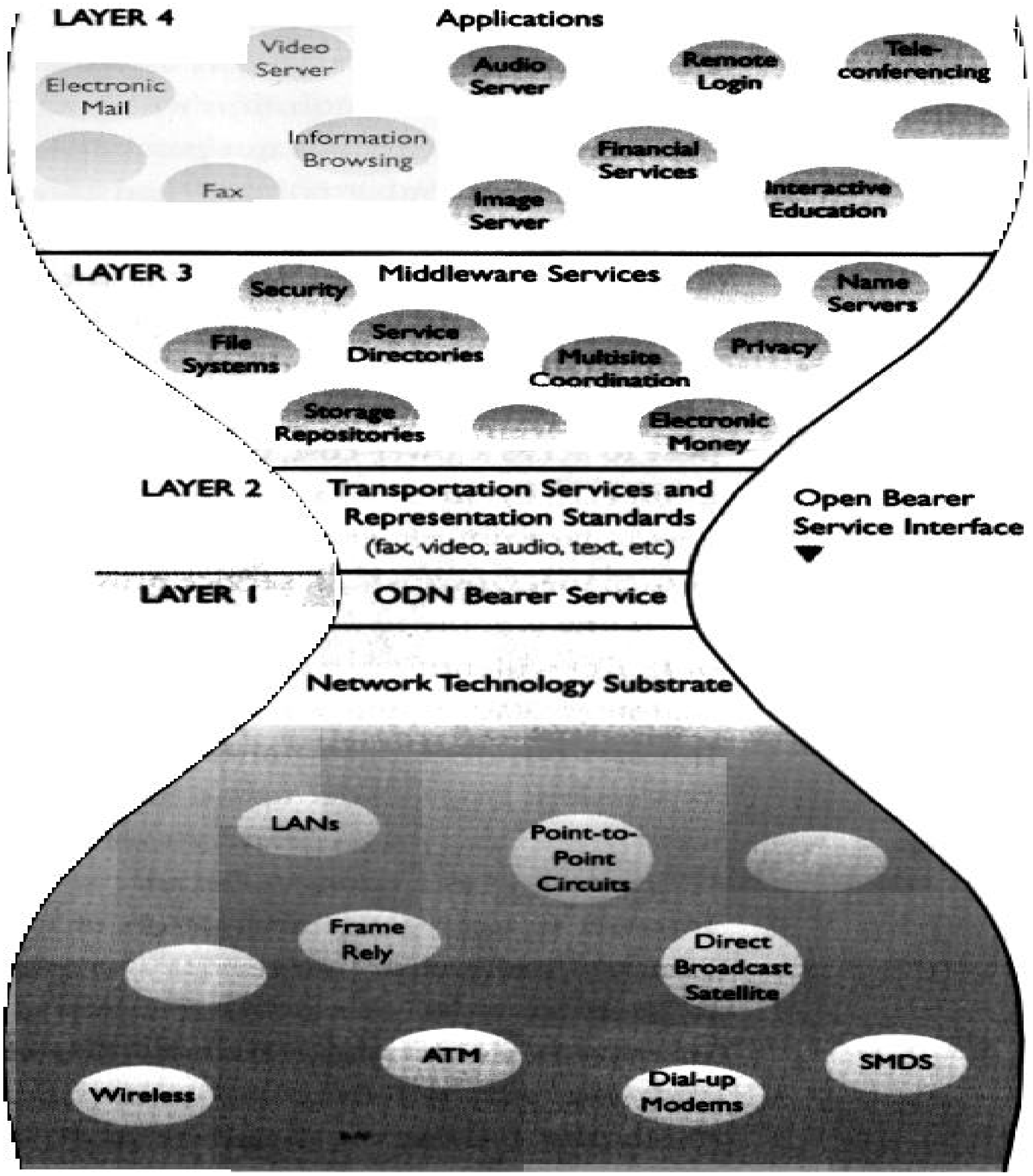
In 1994, just as the commercial Internet was taking off, a National Research Council publication referred to the Internet as a "bearer" service. It underscored the concept of open access: "An open network is one that is capable of carrying information service of all kinds from suppliers of all kinds to customers of all kinds, across network service providers of all kinds, in a seamless accessible fashion."[52]

Exhibit II-2 presents the graphic the NRC used to convey the importance of the bearer service. It draws attention to the fact that the open data network and protocols at the neck of the hourglass are the link between diverse networks and a broad range of applications. Not surprisingly, the NRC chose the then current example to make its point: "The telephone system is an example of an open network, and it is clear to most people that this kind of system is vastly more useful than a system in which the users are partitioned into closed groups based, for example, on the service provider or the user's employer."[53] The principles of openness it identified bear repeating:

> *Open to users.* It does not force users into closed groups or deny access to any sectors of society, but permits universal connectivity, as does the telephone network.
>
> *Open to providers.* It provides an open and accessible environment for competing commercial and intellectual interests. It does not preclude competitive access for information providers.
>
> *Open to network providers.* It makes it possible for any network provider to meet the necessary requirements to attach and become a part of the aggregate of interconnected networks.
>
> *Open to change.* It permits the introduction of new applications and services over time. It is not limited to only one application, such as TV distribution. It also permits new transmission, switching, and control technologies to become available in the future.[54]

Interestingly, when the FCC officially abandoned its policy of ensuring open access to the communications networks, leading technology firms joined in the call to preserve open access. The High Tech Broadband Coalition asked the FCC to "protect important

Exhibit II-2: The Internet As A Bearer Service



Source: National Research Council, *Realizing the Information Future* (Washington, D.C: National Academy Press, 1994), p. 3.

‘connectivity principles’ that have made the Internet what it is today.”[55] They offered four principles:

> Consumers have a right to meaningful information regarding technical limitations of their service.
>
> Consumers should have unrestricted access to their choice of Internet content using the bandwidth capacity of their service plan.
>
> Cable modem customers should be allowed to run applications of their choice, as long as they do not harm the provider’s network and are within the bandwidth limits of their service plans.
>
> Consumers should be permitted to attach any devices they choose, without prior permission, to their ISP connection, so long as they operate within the agreed bandwidth and do not harm the provider’s network or enable the theft of services.[56]

The High Tech Broadband Coalition is made up of entities that supply most other non-transmission components for the digital platform. In essence, the Coalition is advocating nondiscrimination or neutrality of the network for consumers so that vigorous competition can continue between developers and suppliers of devices, applications and content. The effect of this “network neutrality” would be to restore or ensure the fundamental principle that service originating on one network would be able to interconnect with and utilize the functionality of all other networks, thereby preserving the Internet as a network of networks.

The Internet distribution technology or bearer service transforms economic activity, opens new markets, and supports even faster development than previous transportation and communications revolutions have typically done. As a business text observed:

> Taken together these critical features of the Internet are understood by economics by generalizing the concept of the Internet’s bearer service through the idea that the Internet acts as a general-purpose technology or platform technology. The reduced transaction costs and positive network externalities often found on the Internet enable new products to be brought to market more easily and quickly than in the past.[57]

Critical communications technologies have the most dramatic impact on society and there is a tendency to link them together as analogies when describing the impact of the Internet. For example, Mark Buchanan observes that “[t]he Internet has doubled in size yearly for ten straight years, which amounts to an explosive thousand-fold increase in the number of computers connected to it. In fact, it has grown in influence even more rapidly than did the telephone early in the twentieth century.”[58] The implication is that the telephone had a major impact, but the impact of the Internet is even greater. Buchanan goes on to cite an observation by Peter Drucker from 1998 that compared the Internet and the railroad in a way that emphasizes the melding of technologies into communications platforms that transform society:

> As [Drucker] sees it, the computer is akin to the steam engine, and the Information Revolution is now at the point at which the Industrial Revolution was in the 1820s. Drucker points out that the most far reaching changes of the Industrial Revolution came not from the steam engine itself, but as a consequence of another unprecedented invention the engine made possible – the railroad. Similarly, he suspects, it is not computers or the Internet that will be world-changing, but rather one of their recent spin-offs: "E-commerce is to the Information Revolution what the railroad was 170 years ago, e-commerce is creating a new and distinct boom, rapidly changing the economy, society and politics."[59]

Joel Mokyr points to electricity as a better referent.[60] Describing the semiconductor's "unusual properties" as "its ability to recombine with other techniques, its complementarity with downstream innovations, and its consequent pervasiveness in many applications,"[61] Mokyr concludes that it "merits the term general purpose technology."[62] Picking up a theme mentioned earlier, he argues:

> there have been few comparable macroinventions since the emergence of electricity in the late nineteenth century… What has happened is the emergence of a large cluster of separate innovations with an unusual propensity to recombine with one another and to create synergistic innovations which vastly exceeded the capabilities of the individual component… The significance of ICT, then, is not just in its direct impact on productivity but that it is a *knowledge technology* and thus affects every other technique in use.[63]

OPEN COMMERCE AND COMMUNICATIONS NETWORKS: A CORNERSTONE OF CAPITALISM

In the half decade after Drucker's observation, e-commerce has lived up to its advanced billing. Interestingly, the railroads created both boom and bust cycles, but drove an industrial spiral upward, just as the Internet has. Moreover, dramatic transformations such as these also go hand-in-hand with major institutional transformations in the economy. The railroad age saw the growth of the corporation, as the digital communications platform is now transforming business organizations.[64] I argue in this section that critical decisions to ensure non-discriminatory access to the emerging dominant means of communications at the end of the 19th century – the railroad and telecommunications network – played a critical role in the subsequent success, just as the decision to keep the telecommunications network open for enhanced and information services did at the end of the 20th century.

The dynamic effect of open communications networks in the digital age is only the most recent iteration of a broader process that has been unfolding over half a millennium. I have noted that the "Computer Inquiries" were an evolution of the common carrier principles to preserve open communications in the information age. We gain another perspective on the importance of open communications networks by placing recent developments in the longer sweep of history. By doing so we find that open communications and transportation networks are deeply embedded in the very DNA of capitalism.

As capitalism was dissolving feudalism, the emerging social order discovered an important new social, political and economic function – mobility. Physical and social mobility were anathema to feudalism, but essential to capitalism and democracy. Providing for open and adequate highways of commerce and means of communications were critical to allow commerce to flow, to support a more complex division of labor and to weave small distant places into a national and later global economy.

Legal obligations of common carriage and nondiscrimination were the solution.[65] For example, under common law, innkeepers were obligated to serve all travelers, thereby supporting the movement of people, goods and services. Not only were all to be served on a nondiscriminatory basis, but when the innkeeper hung out his sign he brought upon himself the obligation to protect the property of the traveler. A legal text provides the following summary:

> There is also in law always an implied contract with a common innkeeper, to secure his guest's goods in his inn… Also if an innkeeper, or other victualer, hangs out a sign and opens his house for travelers, it is an implied engagement to entertain all persons who travel that way; and upon this universal *assumpsit*, an action on the case will lie against him for damages, if he without good reason refuses to admit a traveler.[66]

Inns were critical to commerce since, given the technology of the time, only short distances could be covered before rest and sustenance were needed. As critical as inns were to the flow of commerce, obviously roads and waterways were more important. Navigation projects, canals and turnpike trusts chartered under obligations of providing service to the public were the early vehicles of the capitalist political economy to provide for transportation projects.[67] Created in the 15th through 18th centuries and building on principles of common law, these were private undertakings with a public franchise to collect tolls on the section of a road or waterway whose upkeep was the responsibility of the trustee. Fees were assessed and access provided on a nondiscriminatory basis. While different rates could be charged to different types of traffic, discrimination within categories was forbidden.

By the 19th century, however, direct public responsibility for roads became the norm and provided nondiscriminatory access. Maintaining a network of transcontinental roads became a governmental responsibility, first city, then state, then national. Later, the principles of nondiscriminatory access were carried through to all national communications and transportation networks. Roads and highways, canals, railroads, the mail, telegraph, and telephone, some owned by public entities, most owned by private corporations, have always been operated as common carriers that are required to interconnect and serve the public on a non-discriminatory basis. An early court decision regarding telecommunications provides an interesting historical perspective:

> The telephone has become as much a matter of public convenience and of public necessity as were the stagecoach and sailing vessel a hundred years ago, or as the steamboat, the railroad, and the telegraph have become in later years. It has already become an important instrument of commerce. No other known device can supply the extraordinary facilities which it affords. It may therefore be regarded, when relatively considered, as an indispensable instrument of commerce. The relations which it has assumed towards the public make it a common carrier of news – a common carrier in the sense in which the telegraph is a common carrier – and impose upon it certain well defined obligations of a public character. All the instruments and appliances used by the telephone company in the prosecution of its business are consequently, in legal contemplation, devoted to a public use.[68]

The early date of this observation, 1886, is notable, since the telephone had just begun to penetrate, but so too is the comprehensive sweep of history. The telephone network was in its infancy but its vital nature brought the obligation of a common carrier upon it. Telephones would soon become a dominant means of business communication. Traditional practice did not excuse it from public interest obligations because it was new. Moreover, this citation also suggests the dual nature of communications networks as both a means of commerce and a means of democratic expression.

CONSTANCY OF THE PRINCIPLE, EVOLUTION OF ITS IMPLEMENTATION

Interestingly, the railroads, whose transcontinental network was completed only two decades before the decision cited above, had already brought upon themselves specific legislation to impose regulation beyond simple common carriage because of anticompetitive and discriminatory business practices. Because they practiced price gouging and discrimination against shippers and localities, direct regulation was imposed on them, first at the city level, but later at the state level and ultimately the national level.

These large corporate entities had failed to be restrained by the common law principles of common carriage or the common law principles were inadequate to the more complex reality of industrial society. As the Collum Committee found, "the paramount evil chargeable against the operation of the transportation system of the United States as now conducted is unjust discrimination between persons, places, commodities, or particular descriptions of traffic."[69] More discipline was needed to protect the public interest; society responded with specific obligations of nondiscrimination and interconnection and the provision of service at just and reasonable rates.

It is an important historical theme that the transformation of the economy in the second industrial revolution gave rise to new forms of economic organization that seemed unwilling to be bound by principles of commerce that were critical to the maintenance of a dynamic capitalist economy. Private contract and common law had failed to promote the public interest and were replaced by more direct public obligations. Moreover, as the nature of the economy and economic organization change, the nature of conduct that is considered anti-social changes as well. The American century was built, in part, on a repeated reaffirmation of the commitment to open communications and transportation networks (e.g., the Interstate Commerce Act (1887), the Mann Elkins Act (1910) and the Communications Act (1934)) and to competitive principles (the Sherman Act (1880), the Clayton Act (1914) and the Federal Trade Commission Act (1914)).

Telecommunications has followed a path similar to the railroads with respect to regulation. Common law principles of nondiscriminatory access began to break down in the railroad industry in the 1850s, when railroads began to assert a right to carry their own goods and discriminate against shippers and geographic locations. Over the course of several decades, governments reacted by subjecting them to regulation that included, but went beyond, common carriage.

The dominant telecommunications entity also failed to provide nondiscriminatory interconnection at the end of the 19th century. Common law could not effectively force access and private entities could not negotiate it. By the early 20th century, states entered, imposing regulation that embodied common carrier principles and more. Eventually the federal government followed the same course. While advocates of proprietary carriage complain that the decision to impose public obligations cut off the public policy debate and short-circuited the private process, several decades of failure with an increasingly ubiquitous bearer service imposed substantial harm on localities and users of the network.

Almost a decade after the introduction of high-speed Internet into the mass market, the pattern is being repeated. A federal district court has twice ruled that advanced telecommunications should be subject to the obligation of non-discrimination, but the network owners are resisting. The court could not have been clearer on this point:

> Among its broad reforms, the Telecommunications Act of 1996 enacted a competitive principle embodied by the dual duties of nondiscrimination and interconnection. See 47 U.S.C. S 201(a) …S 251(a)(1)… Together, these provisions mandate a network architecture that prioritizes consumer choice, demonstrated by vigorous competition among telecommunications carriers. As applied to the Internet, Portland calls it "open access," while AT&T dysphemizes it as "forced access." Under the Communications Act, this principle of telecommunications common carriage governs cable broadband as it does other means of Internet transmission such as telephone service and DSL, "regardless of the facilities used."… The Internet's protocols themselves manifest a related principle called "end-to-end": control lies at the ends of the network where the users are, leaving a simple network that is neutral with respect to the data it transmits, like any common carrier. On this rule of the Internet, the codes of the legislator and the programmer agree.

As happened a century earlier, states and cities have entered the fray. Events may move a little faster because, in the age of the digital communications platform, harm mounts more quickly. Time speeds up and the platform has a more profound effect on the remainder of society, but the fundamental issue is the same.

Current arguments against obligations to provide nondiscriminatory access are based on the claim that competition exists between two networks and that that is all the American economy needs. That claim is wrong as a matter of historical fact and practical experience. Opponents of an obligation for nondiscrimination have mistakenly set up a mutually exclusive choice between competition and public obligations.[70]

The notion that two competitors are enough to ensure a vigorously competitive market is inconsistent with economic theory and decades of empirical evidence. Monopoly is not now and never has been a necessary legal condition for common carrier status. The existence of intermodal competition in other industries did not eliminate the obligation for nondiscrimination. The paramount concern is the nature of the service, not the conditions of supply. Public convenience and necessity is required of a service because it is a critically important, indispensable input into other economic activity. The function provided by and the network characteristics of transportation and communications industries are conducive to creating the conditions for "affecting the public interest."

Starting from the demand side to arrive at common carrier obligations does not mean that the conditions of supply do not matter. On the supply-side, a key characteristic of common carriers is the reliance on some public resource for the deployment of the network. Transportation and communications networks are typically the beneficiaries of public largesse or special considerations. The public support may take one of many forms, such as public funds, use of public property, the right to condemn private property, or the grant of a franchise.

The manner in which the service is offered to the public is also important. Service that is made widely available to the public becomes "affected with the public interest." The presence of market power over a vital service is another factor that leans in favor of common carriage status. However, viewed in this way, the presence of market power on the supply side is only one of several considerations in determining whether an obligation for nondiscrimination should be applied to a particular service, and by no means the most important.

Public roads competed against privately owned canals, but they were both subject to common carrier obligations. Private railroads were added to compete with canals and roads, and they were all subject to common carrier obligations. Telegraph, wireline telephone and wireless are all common carriers. In other words, we have layered alternative modes of communications one atop another, each using a different technology, each optimized for a somewhat different form of communications, and still we imposed the common carrier obligations to ensure access. Access to the means of communications was too important to allow discrimination. That access should play a critical role in the digital revolution is not surprising.

> Access in the form of search engines that allow an individual to find some known piece of useful knowledge at low cost becomes critical. Indeed, it must be true that had useful knowledge grown at the rate it did without changes in the technology of access, diminishing returns might have set in just due to the

gigantic scale… It may be that the Internet 2 will be the culmination of this process, but in fact access has been improving for decades in the form of computer-based information databases such as computerized library catalogs, databases, and online access channels such as Medline. As people who carry out technological instructions – let alone those who write new ones – have access to more and more useful knowledge, the means by which they can access, sort, evaluate, and filter this knowledge is crucial.[71]

III. NETWORK THEORY

It is easy to look at the powerful technologies that have converged in the digital communications platform and assume that they are the engines of change. This is particularly the case in the presence of positive feedback loops. In this section, I argue that the architecture of the network in which they have become embedded is at least as important. The technologies themselves would not be as powerful nor would the effect on the rest of society be as great if the platform had not evolved as an ultrarobust network. This section describes some of the key elements in the understanding of networks that has been emerging across a number of disciplines in the physical and social sciences.[72] There are three primary reasons for turning to this literature.

First, the fact that science is finding a basic set of principles explaining the success of networks ranging from cells and simple life forms to the human brain and social institutions, like firms and social movements, highlights the importance of network principles. The architecture of the network dictates its robustness. The digital communications platform is a layered set of networks that exhibits particularly robust characteristics.

Second, individual networks are frequently part of a larger physical organism or social organization. In other words, networks of networks create larger systems. The digital communications platform is a critically important technology network that deeply affects the social, economic and political structure of society.

Third, the social scientific application of network theory has been policy oriented in the sense that it seeks to identify characteristics of social networks that can be changed to improve their robustness. The theory emphasizes success and failure based on the ability and willingness of institutions to adopt structures that adapt to changing environments and new challenges.

COMPLEX NETWORKS

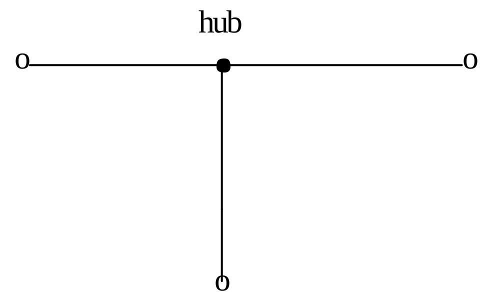
Network Elements

Networks are built from nodes (or endpoints) connected through communications links.

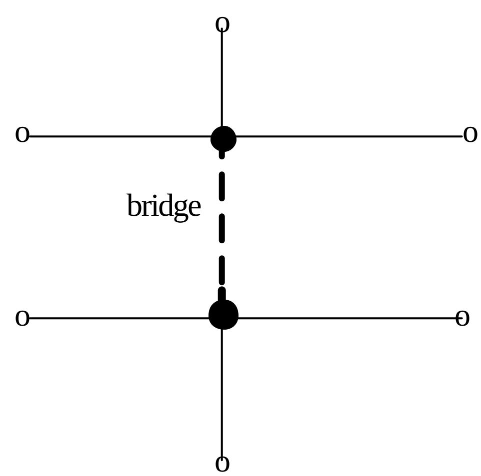
o————————o————————o

node link node…….link node

Interconnectivity is a critical feature of networks. It prevails because "most systems displaying a high degree of tolerance against failures share a common feature: their functionality is guaranteed by a highly interconnected network."[73] Simply put, it "seems that nature strives to achieve robustness through *interconnectivity*."[74] Robust networks are typified by the formation of hubs: "the few highly connected nodes that keep these networks together."[75]



The links between hubs are especially important as bridges that hold the network together.



"In robust networks, hubs and links form modules."[76] Modules share strong internal ties and specialize in discrete functions, but have weak ties to the rest of the network through links between hubs. Modularity implies a division of labor. That is, specialization allows modules to provide functions efficiently in the network.[77]

The modules in a robust network are hierarchically organized:

> Numerous small, but highly interlinked modules combine in a hierarchical fashion to a few larger, less interlinked modules…. Hierarchical modularity sheds new light on the role of the hubs as well: they maintain communication between the modules. Small hubs have links to nodes belonging to a few smaller modules. Large hubs… [are] bridging together communities of different sizes and cultures.[78]

Networks grow and establish structures according to rules that foster efficient structures. Hubs form because of preferential attachment,[79] but links are not added randomly because "building and maintaining new ties… leaves individuals less time for production; hence both congestion and ties are costly."[80]

Networks can be designed in various ways depending on the pattern of the links. The links can be connected in various ways including centralized (Exhibit III-1a), decentralized (Figure III-1b), and distributed (Exhibit III-1c).

Networks gain robustness by creating links that reduce effort. Duncan Watt calls them shortcuts. The dictionary definition of a shortcut captures the essence of the process: "a method of doing or achieving something more directly and easily than by ordinary procedure… to make the work more simple and easy."[81] Watts notes that "[a]n obvious approach is to bypass the overtaxed node by creating a shortcut, thus rechanneling the congestion through an additional network tie."[82]

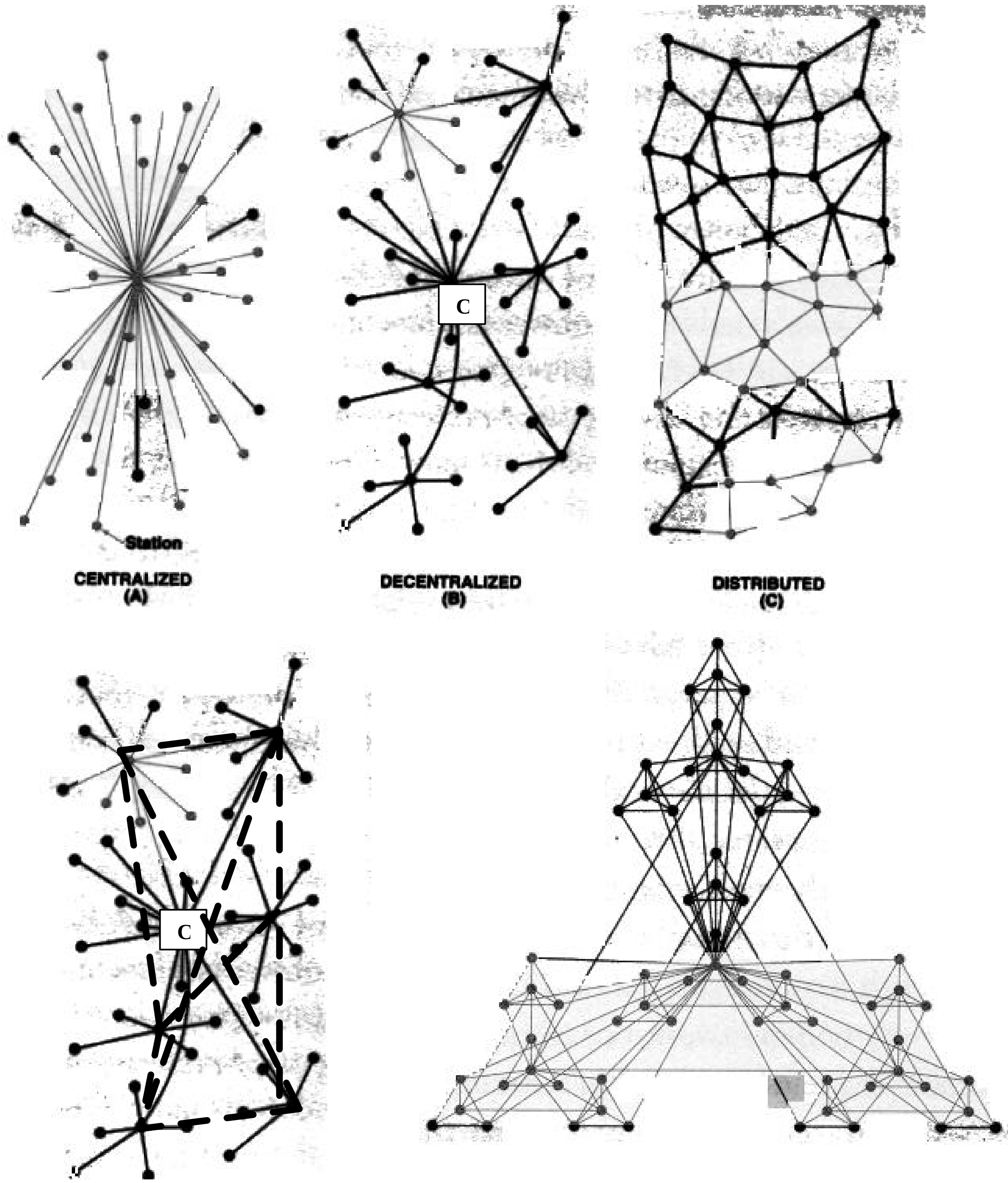
But, which links are most important to forge?[83] The answer that emerges is familiar to anyone who has studied the Internet: distributing communications increases efficiency. The expenditure of time and effort (energy) are critical factors in efficient structures. Watt's theoretical analysis finds that "[t]he addition of a single shortcut contracted the paths between many distant pairs of nodes simultaneously, thereby effectively reducing congestion along many long chains of intermediaries."[84] Buchanan notes that this is a pervasive principle: "Whatever the setting, computation requires information to be moved about between different places. And since the number of degrees of separation reflects the typical time needed to shuttle information from place to place, the small-world architecture makes for computational power and speed."[85]

> [T]he burden of any particular node can be relieved by the greatest possible amount by connecting the neighbors for whom it relays the most messages… Because the strategy always selects the most congested node to relieve, and because the nodes that it connects were handling those messages anyway, the effect is always to reduce overall congestion without increasing any individual's burden.[86]

We might call this the principle of distributed efficiency. There is a tension between preferential affiliation, in which hubs gain links, and distributed efficiency, in which important shortcuts bypass hubs that have become congested or overburdened and allow nodes to communicate. Nevertheless, the value of distributed efficiency can be easily identified.

Exhibit III-1d adds distributed efficiency links (dashed lines) into a decentralized hub-dominated network. Buchanan calls the links between hubs "bridges," drawing on Mark Granovetter's observation that "weak links are often of greater importance than strong links because they are the crucial ties that sew the social network together."[87]

Exhibit III-1: Network Configurations



DECENTRALIZED AND DISTRIBUTED
(D)

MODULES ORGANIZED IN A DECENTRALIZED AND DISTRIBUTED HIERARCHICAL NETWORK
(E)

Sources: Barabasi, Albert-Laszlo, *Linked* (New York: Plume, 2002), A-C = p. 145, E = p. 233.

Important shortcuts (bridges) meet the criteria of reducing traffic between neighboring hubs that are already in communication through a third hub. By adding bridges to the decentralized network, it gains the characteristics of a distributed network. The example in Exhibit III_1d has the following characteristics:

(1) By adding links at the periphery, congestion of the core is reduced. Communications capabilities are distributed to the nodes or endpoints.

(2) The additional links can relieve a great deal of traffic that had flowed through the central hub (c). Therefore, the network should have the necessary resources to free up to form the new links.

(3) Moreover, as configured, if module (c) is removed or rendered inoperative, all clusters could communicate with one another, a condition that did not obtain in the purely decentralized network.

(4) Under routine functioning, no node is separated by more than two degrees (one link, one bridge) from any other hub.

(5) Under stress, should any module be removed, no node is more than three steps (one link, two bridges) from any other hub.

(6) No matter how many modules are taken out, all the remaining nodes can continue to communicate although it becomes more difficult since each communication must traverse more bridges.

While we tend to "see" networks as nodes and hubs and measure them by counting the quantity or assessing the quality of messages that flow between them, the architecture of the network is dictated by rules of communications and connectivity. In the robust, efficient network, information flows because it can (connectivity) and should (functionality). The architecture makes the observed pattern of communications between nodes and hubs possible.

The Architecture of Ultrarobust Networks

Watts describes a special characteristic of robust networks that result from balancing these architectural principles as multiscale connectivity, and the network architecture that exhibits superior performance as an ultrarobust network. He describes the importance of multiscale connectivity in terms of avoiding or recovering from failure and also in facilitating success:

> Multiscale connectivity, therefore, serves not just one but two purposes that are essential to the performance of a firm in uncertain environments. By distributing the information congestion associated with problem solving across many scales of the organization, it minimizes the likelihood of failure [maximizes the chances for success]. And *simultaneously* it minimizes the effect of failures [maximizes the impact of successes] if and when they do

> occur… Because they exhibit this two-for-the-price-of-one robustness property, we call multiscale networks ultrarobust.[88]

The hierarchical, modular network that exhibits both decentralized and distributed communications traits allows experimentation at the periphery, without threatening the functionality of the network (see Exhibit III-1e). Failure is not catastrophic; since it can be isolated and its impact minimized. Success can be pursued independently and exploited because of efficient communications. Successful nodes grow more rapidly through preferential attachment.

> Hierarchical modularity has significant design advantages. It permits parts of the network to evolve separately… The impact of genetic mutations [experimentation or innovation], affecting at most a few genes at once, is limited to a few modules. If a mutation is an improvement, the organism with the superior module will flourish. If, however, tinkering with a gene decreases the module's fitness, the organism will fail to survive.[89]

Watts goes on to identify searchability as a critical and "generic property of social networks."[90] Searchability is facilitated by paying attention to one's neighbors (chosen by preferential attachment).[91] As he puts it: "By breaking the world down the way we do – according to multiple simultaneous notions of social distance – and by breaking the search process itself down into manageable phases, we can solve what seems to be a tremendously difficult problem with relative ease."[92]

Searchability is one of the key advantages of multiscale networks because "in ambiguous environments, information congestion related to problem-solving activities causes individuals – especially those higher in the hierarchy – to become overburdened. The local response of these individuals is to direct their subordinates to resolve problems on their own by conducting directed searches."[93] Watts argues that "[w]hen problem solving is purely local, requiring messages to be passed between members of the same work team, for example, or subscribers to the same ISP, congestion can be relieved effectively by a process that corresponds to *team building*."[94]

> Lacking a central directory of organizational knowledge and resources, the subordinates rely on their informal contacts within their firm (or possibly in other firms) to locate relevant information… A direct consequence is that the internal architecture of the firm is driven away from that of a pure hierarchy by virtue of the new links that are being formed and consolidated over many repeated searches.
>
> The equilibrium state of this process is a multiscale network for the simple reason that only when the network is connected across multiple scales is individual congestion – hence the pressure to create new connections – relieved… the process of ties at multiple scales also renders the network highly searchable, so that the multiscale state becomes effectively reinforcing.[95]

Albert Barabasi notes that the Internet "evolves based on local decisions on an as needed basis… The underlying network has become so distributed, decentralized, and locally guarded that even such an ordinary task as getting a central map of it has become virtually impossible."[96] Exhibit III-2 presents a picture of what the publisher's note refers to as "the original proposal for the World Wide Web."[97] It is a module in the larger network whose function is to organize resources to manage information. It exhibits all of the characteristics of the networks I have described. It has hierarchy based on preferential affiliation (e.g. the "proposal mesh") with both decentralized clusters and bridges to achieve distributed efficiency. Note that not all bridges are built between hubs, reflecting the author's understanding of how information flows within the module. Only some bridges need to be built.

I have pointed out that several of the key components of the digital communications platform – the telecommunications facility, the appliance (PC), and the communications protocols (Internet and the web) – were open. The PC itself is considered a "platform," whose complementary elements exist in an open architecture. The Internet is a "stack" of protocols whose architecture is open. In other words, the digital communications platform is a nested set of open components that exhibit an unprecedented level of connectivity. It exhibits the modular, hierarchical, distributed, multiscale connectivity of an ultrarobust network.

INNOVATION IN HIGH TECHNOLOGY INDUSTRIES

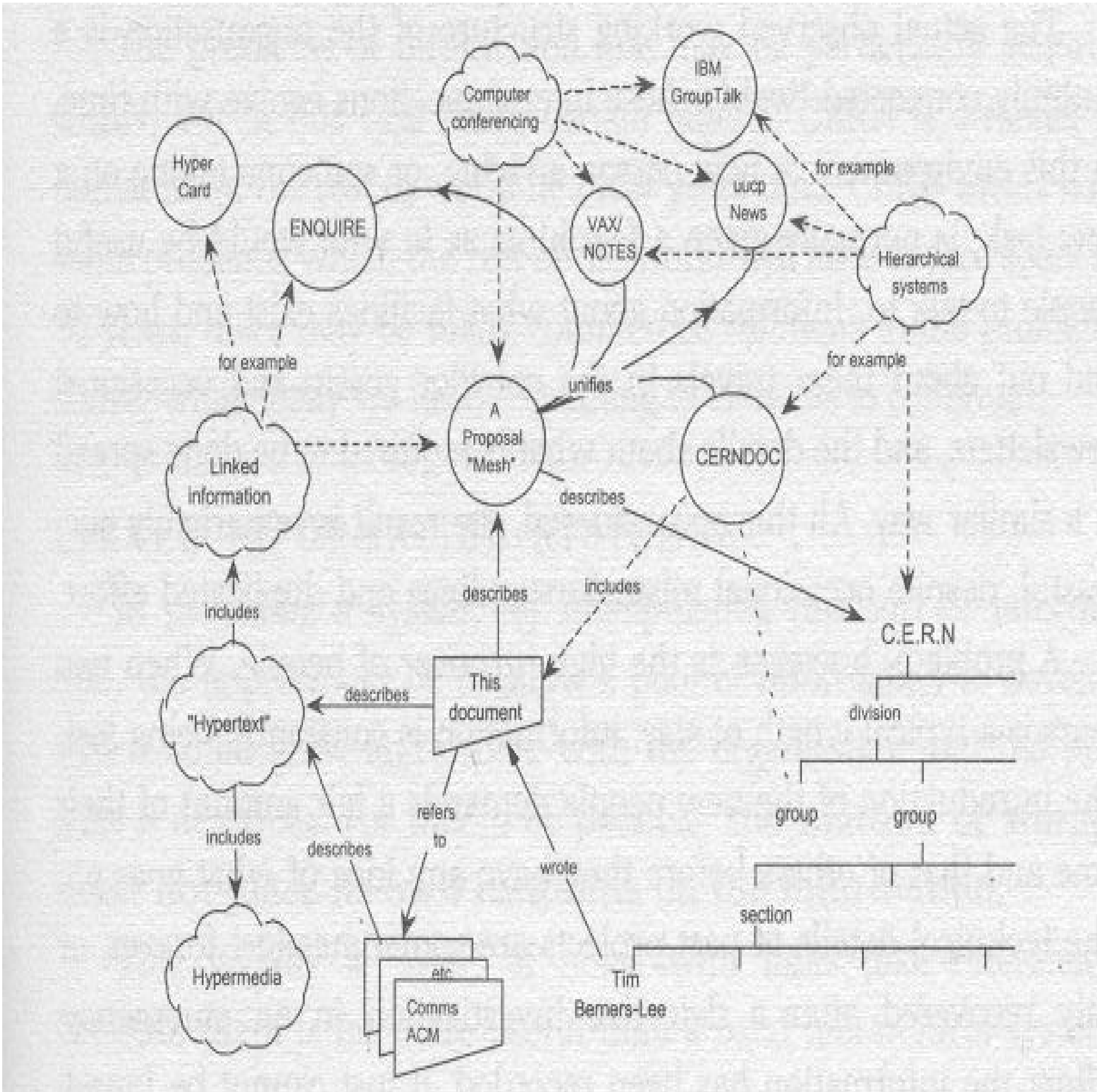
The Technology of Technical Change

Networks are critical to innovation, which "spreads from innovators [nodes] to hubs. The hubs in turn send the information out along their numerous links, reaching most people within a given… network."[98] Most importantly, "the structure of the network can have as great an influence on the success or failure of an innovation as the inherent appeal of the innovation itself."[99] The same tension exists for innovation as exists for all problems confronted by the network. "[T]he success of an innovation appears to require a trade off between local reinforcement and global connectivity."[100]

> Networks that are not connected enough, therefore, prohibit global cascades because the cascade has no way of jumping from one vulnerable cluster to another. And networks that are too highly connected prohibit cascades also, but for a different reason: they are locked into a kind of stasis, each node constraining the influence of any other and being constrained itself.[101]

Multiscale connectivity in hierarchical, modular architecture is the sweet spot between underconnected and overconnected networks and ideal for problem solving "by making problem solving itself a routine activity."[102] Effective adoption of an innovation or response to a disaster requires the ability to search the network for solutions and synchronize the modules when one is found.[103]

Exhibit III-2: The Original Proposal For The World Wide Web



Sources: Berners-Lee, Tim, with Mark Fischetti, *Weaving the Web: the Original Design and Ultimate Destiny of the World Wide Web* (New York: Harper Business, 1999), p. 211.

> Routine problem solving both balances the information-processing burden across the individuals of an organization and sets up the conditions under which exceptional problems can be solved.
>
> The precise *mechanism* by which a firm's response to routine ambiguity generates ultrarobustness is, as yet, an unsolved puzzle, but it seems to bear a deep resemblance to the property of network searchability.[104]

I have already suggested the link between the Internet and innovation in the concept of a bearer network. Applying network theory establishes the link between the digital communications platform and the stimulation of innovation with much greater detail. Recent analyses of technological innovation provide strong evidence that the digital communications platform transformed the very fabric of the innovation process of what Ashish Arora et al. call "the changing technology of technical change."[105] Consider the following description of the innovation process:

> von Hippel notes that greater efficiency can be achieved by dividing the overall problem-solving effort into tasks, showing maximal interaction within them and minimal interactions across them. In doing so, one can reduce one fundamental source of inefficiency, notably that actions in one particular innovation stage or activity may require information or even exchanges of actions in several other innovation stages or activities. This is a source of inefficiency because of the extensive coordination and information flow that this process requires and the potential disruptions that may be brought about by these interdependencies… [H]e argues that the development of innovations often relies upon information that is in the domain of different agents (e.g. the user and the manufacturer), and that some of this information can be "sticky" in the sense that it can only be transferred at very high costs to other parties. This information arises from tacit knowledge and the routines that are normally associated with the ordinary activities performed by each agent or organization.[106]

Technological innovation is framed as an information problem that challenges the network structure. There are two hurdles. First, knowledge is local and flowing it through hubs to solve problems creates inefficiency (uses energy). Second, the possibility of failure increases as the number of interrelated problems that must be solved sequentially increases, because of dependence on multiple solutions to problems across numerous nodes.

The solution to the first problem is to distribute responsibility:

> The traditional approach in this type of situation has been to try to move the sticky information…. [S]ystem developers would first undertake a great deal of work at the user site (e.g., a bank or an insurance company) to understand the needs for the system to be produced. Once they acquired this information, the developers returned to their company and designed it… [A] more effective approach would be to move the locus of the problem-solving effort. The user

> and the producer could then draw only upon their own local and idiosyncratic information sets, without having to move between locations.[107]

The parallel to the network problem is quite strong. Efficiency in technological innovation comes by breaking the problem down and solving it at the "local" level because local information is the ultimate source of the solution. The solution is efficient as long as one economizes on the need to flow information up through the hierarchy. When problem solving moves to the local level, the cluster must become modular. Modularity plays the same role in the context of technological innovation as it does in the broader network theory.

The solution to the second problem – sequential challenges – emerges from modularity with open interfaces. It loosens the dependence on simultaneous solutions to multiple problems:

> Modularity is a key component in a system of open architecture. Modularity in product design has received some attention in recent years due to its perceived advantages for innovation, particularly in view of shorter product life cycles, which reduce time-to-market and the growing value of product customization…
>
> This had natural implications for innovation. Most notably, provided one did not change the required interfaces, a great deal of innovation could take place in the components without requiring redesign of other components or of the entire architecture.[108]

The local nature of the robust network is not confined to the internal organization of firms. It extends to the network environment in which the firm exists. Silicon Valley has been described as a matrix,[109] essentially a multiscale network of firms of various sizes in which sticky knowledge spreads through links that "fall somewhere between market and firm. These hybrid links are most easily formed where interfirm relations are close, the lines between them dense."[110] The effect of "this sort of density is particularly important in fast-changing areas of the economy, in which all partners to a venture need to be able to change in coordinated fashion."[111] The proximity also facilitates modularity and specialization since "density... also allows people to differentiate finely between different firms, finding the most apt for a particular task or idea."[112] Key to the unbundling[113] of the production process is "the region's culture of open information exchange and interfirm mobility, which fosters a culture of recombination and new firm formation."[114] "Much of this innovative activity is less associated with footloose multinational corporations and more associated with high-tech innovative regional clusters, such as Silicon Valley, Research Triangle and Route 122."[115]

The most successful firms and regions take on the characteristics of layered multiscale networks:

> The sum of these associations is a vast network composed of many small networks of contributors to the Valley's process for innovation and entrepreneurship… Tight links built up over time by the rich accumulation of

> shared conversations, projects, and deals have yielded a treasure trove of rich and productive relationships…
>
> The prevailing philosophy of Silicon Valley promotes openness and learning, sharing of information, the co-evolution of ideas, flexibility, mutual feedback, and fast responses to opportunities and challenges… a regional network-based industrial system that promotes collective learning and flexible adjustment among specialist producers of complex related technologies.[116]

A Broad-Based, Transformative Revolution

The technological revolution of the late twentieth century has altered the information environment to make distributed solutions more feasible. The uniquely user-focused character of the communications-intensive Internet solution recurs.

Eric von Hippel argues that "the primary irreversible factor that we speculate is making user-based design an increasingly attractive option is technological advance."[117] Arora et al. note that "the recent evolution of technology and knowledge bases… has created greater opportunities for task portioning."[118] This allows greater local autonomy in decision-making:

> Specifically, the main force behind the changing technology of technical change is the complementarity between increased computational power and greater scientific and technological understanding of problems.[119]
>
> Advances in scientific understanding decrease the costs of articulating tacit and context-dependent knowledge and reduce the costs of technology transfer. Further, such knowledge can be embodied in tools, particularly software tools, which make the knowledge available to others cheaply and in a useful form… [A]dvances in science and the tremendous increase in computational capabilities have greatly contributed to extending the division of innovative labor.[120]

Arora et al. argue that the "changing technology of technical change" allows technological innovation to move outside the firm; others argue that the form of organization changes as well:

> [M]odularity in product design brings about modular organizations… the standard interfaces of a modular design provide a sort of "embedded coordination" among independent firms and innovators, which can coordinate their activities independently of a superior managerial authority. … [M]odular systems that are also open (i.e., where the interfaces are not proprietary standards) make market leaders more vulnerable to competition. While modularity can accelerate overall product innovation, because of the contribution of several specialists, the presence of many specialists can also lead to tougher competition and greater entry.[121]

As hierarchical modularity in the network replaces vertically integrated hierarchy in the firm, complex digital platform industries have benefited from open network approaches. "The open system approach fuels the growth of many smaller innovative firms. The presence of several firms for each subsystem or component, and the narrow focus pursued by each firm will lead to higher degrees of experimentation and innovation with a faster rate of technical progress."[122] Vertical integration and extreme hierarchical structure lose their comparative advantage in the context of open digital communications networks, while modular flexibility and connectivity gain significant advantage:

> Cross-functional interaction must take place concurrently, rather than sequentially, if firms are to cut time-to-market for new products and processes. Cross-functional and cross-departmental networks must be strengthened without causing information overload… If such activity becomes completely unstructured, it augments rather than displaces bureaucracy… With organizational sub-units cross-linked in this way, authority flows as much from knowledge as position in the organizational hierarchy. The challenge is to develop a culture which supports the establishment of cross-functional teams which draw on the requisite knowledge, wherever it may be located.[123]

The rewards to modules and networks that restructure effectively are clear. There is "a strong causal link between productivity gains in the ICT sector and a spread of these productivity improvements throughout the economy via investment in ICT capital."[124]

> When we turn to the assertion that rigorous industrial restructuring in the pre-1990 period may have been beneficial to economic performance, we find that a lack of restructuring indeed appears to have affected economic growth of industries adversely, probably especially for the case of high tech industries… [M]anufacturing industries, especially high tech industries with relatively high speed of restructuring have, *ceteris paribus*, performed best.[125]

Pinpointing the Key Technologies and Interfaces

While the overall thrust of network theory suggests that multiscale connectivity promotes ultrarobust networks, and the digital communications platform is the architecture that holds it together, it also leaves open the optimal mix between hierarchical networks and hierarchical firms.[126] What are the characteristics of technologies that are critical to broad-based progress? It is not hard to find the key to which technologies are important to make available. Arora et al. identify two situations in which the exploitation of available technologies and innovative opportunities can be problematic because private actions are not likely to achieve the optimal outcome. These are essentially collective action challenges.

First there is a strong "public goods" character to information and knowledge:

> The key here is that the knowledge has multiple potential applications, so that users do not compete. When knowledge is nonrival, protecting that knowledge through patents creates potential inefficiencies… A number of different

> potential users may have to get together to invest in creating knowledge. Such contracts are problematic because users will differ in the value they place upon the enterprises and, consequently, are likely to underreport their value.[127]

Second are transaction costs problems "in cumulative or systemic technologies," because "a commercializable innovation may require many difference pieces of knowledge some of which may be patented and owned by people with conflicting interests."[128] This is the platform problem, where many complements must interoperate to achieve the full value of the platform:

> In a Coasian world with no transaction costs, given any initial distribution of property rights over the fragments, agents will bargain to a Pareto optimal solution. More realistically, the required collection of the property rights, although socially efficient, might not occur because of transaction costs and hold-up problems. An agent holding a patent on an important fragment ("blocking patent") may use the patent in an attempt to extract as much of the value of the innovation as possible…
>
> In other words, when several pieces of intellectual property have to be combined, the transaction costs implied could be so high as to prevent otherwise productive combinations.[129]

We could look to a variety of high technology industries to find examples of this process, but we should not be surprised to find that the best examples come from the components of the digital information platform. Interconnection and interoperability to maximize the availability of functionality have been the hallmarks of the open architecture of the digital communications platform.

> Things are different when a firm invests in developing a new platform interface…These are *enabling technologies*. They contain valuable content or information that probably could have value (i.e. price) in the marketplace. But protecting that content, such as by hiding the detailed specifications of the hardware or software interfaces, would defeat their entire *raison d'etre:* Interfaces exist to entice other firms to use them to build products that conform to the defined standards and therefore work efficiently with the platform.[130]

Intel's approach to platform leadership has been widely recognized and it provides a perfect example of the importance of open architecture. Intel "made a decision pretty early on that what we wanted was something that was *open* and *royalty-free* that the industry could adopt without huge concerns about infringing IP [intellectual property] or having to pay high royalties."[131] The distinction from standard-setting bodies is clear. "Generally, their policy is that any interface IP that is introduced into a specification has to be licensed under 'reasonable and non-discriminatory terms.' But 'reasonable' is a very subjective term."[132]

Intel imposed a further requirement of reciprocity: “anyone who would have access to [our] IP – if they had any [of their own] in that area – would have to make their IP open and available to the industry as well.”[133]

Of course, Intel was not the only company to arrive at platform leadership as the key to dynamic innovation. The “Silicon Valley system” is described as one “where relationships are based on a shared recognition of the need to ensure the success of a final product. Traditional supplier relationships are typically transformed by a decision to exchange long-term business plans and share confidential sales forecasts and cost information.”[134]

In short, “where informal connections are dense and the mysteries of practice are in the air, the inefficiencies that keep ideas within isolated firms, hedged in by intellectual property strategies and closely related, are less of a constraint on mobility.”[135]

It is interesting to reflect on the factors that drove Intel to its aggressive approach to platform leadership. The PC had been an open platform throughout its existence, but IBM had chosen that path out of expediency, rather than a conviction about the superiority of an open platform. Caught behind in the shift from mainframes to PCs, IBM was forced to outsource development and supply of many components of the PC to get to market quickly. Open architecture was the answer, but IBM’s commitment to the concept was weak.

> IBM was attempting to evolve the PC architecture in a proprietary manner with a new bus project: MCA. That strategy was in line with IBM trying to maintain (or more precisely, to revert to) a “vertical” industry: that is a structure of industry competition where highly integrated firms made most of their own components and competed on the merits of distinctive, proprietary architecture…
>
> Intel, by contrast, did not try to benefit from proprietary architectural interface for the PC. Instead, the company made sure that the new specification was free and open to everyone… It was in Intel’s best interest for all PC manufacturers and developers of complementary products to plug their products together in the same way to make development of complements as easy and cheap as possible.[136]

A similar sequence of events played out in the development of the Internet’s most important application, the Worldwide Web. As the Internet moved out of the laboratory and into the commercial market, the specter of a closed interface arose. Tim Berners-Lee describes it as follows:

> It was about this time, spring 1993, that the University of Minnesota decided it would ask for a license fee from certain classes of users who wanted to use gopher. Since the gopher software was being picked up so widely, the university was going to charge an annual fee. The browser, and the act of browsing, would be free, and the server software would remain free to

> nonprofit and educational institutions. But any other users, notably companies, would have to pay to use gopher software.
>
> This was an act of treason in the academic community and the Internet community. Even if the university never charged anyone a dime, the fact that the school had announced it was reserving the right to charge people for use of the gopher protocols meant it had crossed the line. To use the technology was too risky.
>
> Industry dropped gopher like a hot potato. Developers knew they couldn't do anything that could possibly be said to be related to the gopher protocol without asking all their lawyers first about negotiating rights… It was considered dangerous as an engineer to have even read the specification or seen any of the code, because anything that person did in the future could possibly be said to have been in some way inspired by the private gopher technology.[137]
>
> Open architecture is a powerful, but fragile, design principle.

CONCLUSION

The discussion has identified several ways in which open platforms have been ensured. Public policy played a key role in the communications network. Platform leadership played a key role in the case of the PC. A third approach, which can best be described as "philosophical," played a critical role in ensuring the Worldwide Web would be open. Its developer held the firm belief (supported by the analysis presented above) that an open architecture is superior for a broad range of purposes.

We are in a critical moment to reaffirm a commitment to open communications platforms because technological and institutional developments in information production are beginning to fulfill the promise of a substantial improvement in both the economy and the polity. The PC-driven Internet has been proven to be an extremely consumer-friendly, citizen-friendly environment for innovation and expression. This has resulted from a largely "open" physical layer – open in the sense of communications devices and transmission networks. The logical or code layer should be open as well, if the end-to-end principle of the Internet is to be fully realized. The end-to-end principle allows interconnection and interoperability in a manner that is particularly well-suited to the economic and political goals of our society. The transparency of the network, and its reliance on distributed intelligence, foster innovation and empower speakers at the ends of the network.

The chaos of economic experimentation and the cacophony of democratic discourse that emanates from an open communications platform model is music to our ears, but the ongoing closure of the third generation Internet has already begun to quiet the chorus.

IV. THREATS TO OPEN COMMUNICATIONS NETWORKS

Collective action problems and positive externalities have been identified as critical justifications for public policies that promote open communications platforms. In this section I argue that the heightened potential for negative, anticompetitive actions by private parties who have a dominant position at key locations of the platform also provide the basis for policies to defend the open architecture of the platform. Antitrust authorities reviewing mergers or evaluating complaints of anticompetitive conduct and Communications Act authorities considering obligations of interconnection and universal service must consider anticompetitive conduct because dominant firms in the critical layers of the platform may have the incentive and ability to protect and promote their interests at the expense of competition and the public.

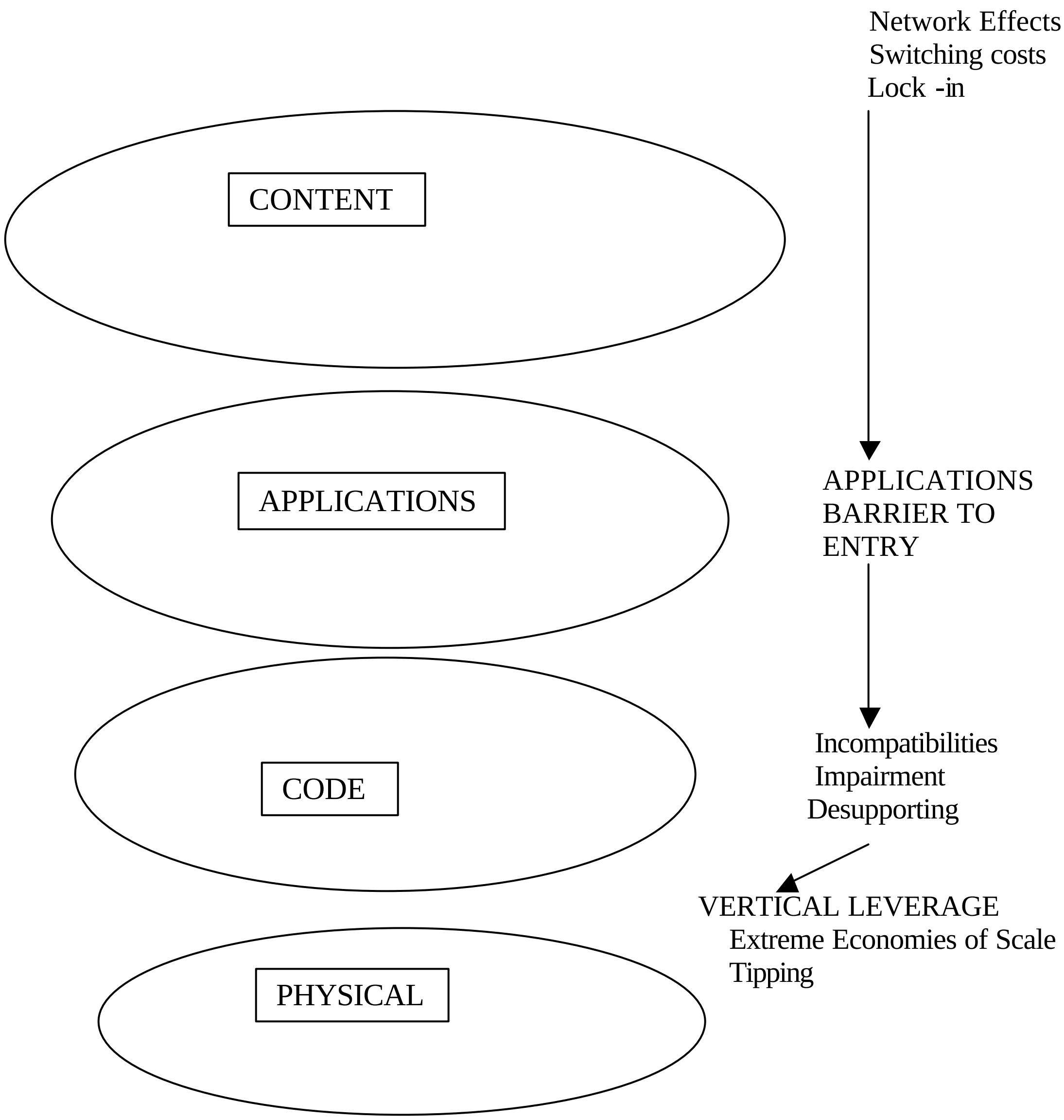
THE THREAT OF MARKET POWER

The vertical nature of the digital communications platform raises new concerns about these anticompetitive behaviors. Competition within a given layer, the equivalent of traditional horizontal competition, can take place without competition across layers.[138] The type of behavior across layers is very important, both because it can promote dynamic change and because it can involve powerful anticompetitive leverage. If it is procompetitive, it can move the whole platform to a higher level of production. If it is anticompetitive, it can be very dangerous. It can pollute a competitive layer and undermine the best basis for introducing competition in a layer that had not hitherto been competitive.

In old economy industries, vertical leverage is exploited by business practices. Companies vertically integrate to internalize transactions. Where concerns about vertical integration have traditionally been raised, they focus on integration for critical inputs across markets. Vertically integrated companies may withdraw business from the open market, driving up the cost of inputs for competitors, or deny supply to the market.[139] If they constitute a large share of the market or refuse to buy or sell intermediate inputs (or raise the costs to rivals) the impact can be anticompetitive. By integrating across stages of production, incumbents can create barriers to entry by forcing potential competitors to enter at more than one stage, making competition much less likely due to increased capital requirements.[140] Exclusive and preferential deals for the use of facilities and products compound the problem. They "reduce the number of alternative sources for other firms at either stage, [which] can increase the costs of market or contractual exchange."[141] Integrated firms can impose higher costs on their rivals, or degrade their quality of service to gain an advantage. "[F]or example, the conduct of vertically integrated firms increase[s] risks for nonintegrated firms by exposing downstream specialists to regular or occasional price squeezes."[142] Vertical integration facilitates price squeezes and enhances price discrimination.[143]

The platform nature of digital communications creates unique new sources of vertical leverage (see Exhibit IV-1). The physical and code layers that lie at the bottleneck of the platform make threats to the openness of the network very potent. They have great leverage because of their critical location. In a platform industry, vertical leverage can take a more

Exhibit IV-1: Unique Characteristics Of Communications Platforms That Raise Special Market Power Concerns



insidious form, technological integration/manipulation.[144] Introduction of incompatibilities can impair or undermine the function of disfavored complements. The ability to undermine interoperability or the refusal to interoperate is an extremely powerful tool for excluding or undermining rivals and thereby short circuiting competition, as is the withholding of functionality. The mere threat of incompatibility or foreclosure through the refusal to interoperate can drive competitors away.[145]

Dominant players in the physical and code layers have the power to readily distort the architecture of the platform to protect their market interests.[146] They have a variety of tools to create economic and entry barriers[147] such as exclusive deals,[148] retaliation,[149] manipulation of standards,[150] and strategies that freeze customers.[151] Firms can leverage their access to customers to reinforce their market dominance[152] by creating ever-larger bundles of complementary assets.[153] As the elasticity of demand declines over the course of the product life cycle, market power lodged in the physical layer results in excessive bundling[154] and overpricing of products under a variety of market conditions.[155] Control over the product cycle can impose immense costs by creating incompatibilities,[156] forcing upgrades,[157] and by spreading the cost increases across layers of the platform to extract consumer surplus.[158]

Scale and scope economies may be so strong in the critical layers of the platform that they may give rise to a unique market characteristic called tipping. Interacting with network effects and the ability to set standards, the market tips toward one producer. Firms seek to accomplish technological "lock-in."[159] These processes create what has been called an 'applications barrier to entry.' After capturing the first generation of customers and building a customer base, it becomes difficult, if not impossible, for later technologies to overcome this advantage.[160] Customers hesitate to abandon their investments in the dominant technology and customer acquisition costs rise for latecomers.

This creates an immense base of monopsony power for dominant players in the critical layers. I use the term monopsony broadly to refer to the ability to control demand. If a firm is a huge buyer of content or applications or can dictate which content reaches the public through control of a physical or code interface (a cable operator that buys programming or an operating system vendor who bundles applications), it can determine the fate of content and applications developers. In fact, network effects are also known as demand side economies of scale. To the extent that a large buyer or network owner controls sufficient demand to create such effects, particularly in negotiating with sellers of products, they have monopsony power.

These anti-competitive behaviors are attractive to a dominant new economy firm for static and dynamic reasons.[161] Preserving market power in the core market by erecting cross-platform incompatibilities that raise rivals' costs is a critical motivation. Preventing rivals from achieving economies of scale can preserve market power in the core product and allow monopoly rents to persist. Profits may be increased in the core product by enhanced abilities to price discriminate. Conquering neighboring markets has several advantages. By driving competitors out of neighboring markets, market power in new products may be created or the ability to preserve market power across generations of a product may be enhanced by diminishing the pool of potential competitors.

The growing concern about digital information platform industries derives from the fact that the physical and code layers do not appear to be very competitive.[162] There are not now nor are there likely to be a sufficient number of networks deployed in any given area to sustain vigorous competition. Vigorous and balanced competition between operating systems has not been sustained for long periods of time.

Most communications markets have a small number of competitors. In the high speed Internet market, there are now two main competitors and the one with the dominant market share has a substantially superior technology.[163] When or whether there will be a third, and how well it will be able to compete, is unclear. This situation is simply not sufficient to sustain a competitive outcome.

Confronted with the fact that the physical and code layers have very few competitors, defenders of closed, proprietary platforms argue that monopoly may be preferable. As the FCC put it, "[s]ome economists, most notably Schumpeter, suggest that monopoly can be more conducive to innovation than competition, since monopolists can more readily capture the benefits of innovation."[164] Thus, some argue that facility owners, exercising their property rights to exclude and dictate uses of the network, will produce a more dynamic environment than an open communications platform.[165] The hope is that a very small number of owners engaging in the rent seeking behavior of innovators will stimulate more investment, and that this enlightened self-interest will probably convince them to open their network. Notwithstanding the clear success of the open communications platform,[166] and the demonstrated unwillingness of incumbent facility owners to open their platforms when they are not required to do so,[167] monopoly proponents tell us that the next generation of the Internet cannot succeed under the same rules of open communications that were responsible for its birth.

This argument is conceptually linked to long-standing claims that "firms need protection from competition before they will bear the risks and costs of invention and innovation, and a monopoly affords an ideal platform for shooting at the rapidly and jerkily moving targets of new technology."[168] Lately this argument is extended to claims that, in the new economy, "winner take all" industries create competition to win the entire market, not to win markets shares within the market. As long as monopolists are booted out on a regular basis, or believe they can be, monopoly is in the public interest.[169]

In a sense, this argument is a return to the pre-Internet logic of communications platforms, in which it is assumed that the center of value creation resides in the physical layer.[170] The contrast with the demonstrated impact of freeing the code and content layers to innovate and add value, while running on top of an open physical layer, could not be more dramatic.

The theory supporting Schumpeterian rents appears to be particularly ill-suited to several layers of the digital communications platform. It breaks down if a monopoly is not transitory, a likely outcome in the physical layer. In the physical layer, with its high capital costs and other barriers to entry, monopoly is more likely to quickly lead to anticompetitive practices that leverage the monopoly power over bottleneck facilities into other layers of the platform.

The theory has also been challenged for circumstances that seem to typify the code and applications layers of the Internet platform.[171] The monopoly rent argument appears to be least applicable to industries in which rapid and raucous technological progress is taking place within the framework of an open platform, as has typified the Internet through its first two decades.[172] The "winner take all" argument was firmly rejected in the Microsoft case.[173] The Internet seems to fit the mode of atomistic competition much better than the creative monopolist rent-seeking model, as did the development and progress of its most important device, the PC.[174]

One of the most important factors in creating a positive feedback process is openness in the early stages of development of the platform.[175] In order to stimulate the complementary assets and supporting services, and to attract the necessary critical mass of customers, the technology must be open to adoption and development by both consumers and suppliers.[176] This openness captures the critical fact that demand and consumers are interrelated.[177] If the activities of firms begin to promote closed technologies,[178] this is a clear sign that motivation may have shifted.[179] While it is clear in the literature that a company's installed base is important, it is not clear that an installed base must be so large that a single firm can dominate the market. Schumpeter's observation deals with the issue of the size of the firm, so that it achieves economies of scale, not the market share of the firm. As long as platforms are open, the installed base can be fragmented and still be large.[180] In other words, a large market share is not synonymous with a large market.[181] A standard is not synonymous with a proprietary standard.[182] Open platforms and compatible products are identified as providing a basis for network effects that are at least as dynamic as closed, proprietary platforms[183] and much less prone to anti-competitive conduct.[184]

FROM THEORY TO PRACTICE

The emerging model for closed communications platforms is one in which the firm with a dominant technology at the central layers of the platform can leverage control to achieve domination of applications and content. Given the hourglass shape of the platform, the critical layers are at the waist of the platform. Proprietary control of network layers in which there is a lack of adequate alternatives allows owners to lock in consumers and squeeze competitors out of the broader market. The observable behavior of the incumbent wire owners contradicts the theoretical claims made in defense of closed platforms. The track record of competition in the physical facilities of telephony and cable certainly should not be a source of encouragement for those looking for dynamic Schumpeterian monopolists.[185] For the last several decades of the 20th century, general analysis concerning vertical integration in market structure was muted. However, a number of recent mergers in the communications industries, between increasingly larger owners of communications facilities, have elicited vigorous analysis of the abuse of vertical market power (e.g., Comcast/AT&T/MediaOne/TCI, AOL/Time Warner/Turner, SBC Communications Inc. (SBC)/Ameritech/SNET/Pacific Bell and Bell Atlantic/GTE/NYNEX).[186] As one former antitrust official put it, "[t]he increasing number of mergers in high-technology industries has raised both horizontal and vertical antitrust issues . . . the interest in and analysis of vertical issues has come to the forefront."[187]

The behavioral analysis in this section relies on a variety of analyses and complaints from participants in the sector including AT&T as a long distance carrier, before it became a cable owner,[188] AOL as an ISP, before it became a cable owner,[189] analyses prepared by experts for local[190] and long distance[191] telephone companies, when they were not effectuating mergers of their own, Wall Street analyses of the business models of dominant, vertically integrated cable firms,[192] and observations offered by independent ISPs[193] and small cable operators.[194]

Current theoretical literature provides an ample basis for concerns that the physical layer of the communications platform will not perform efficiently or in a competitive manner without a check on market power. In this layer, barriers to entry are substantial, and go far beyond simple entrepreneurial skills that need to be rewarded.[195] At the structural level, new entry into these physical markets is difficult. AOL argued that the small number of communications facilities in the physical layer could create a transmission bottleneck that would lead directly to the problem of vertical leverage or market power. "[A] vertically integrated broadband provider such as AT&T will have a strong incentive and opportunity to discriminate against unaffiliated broadband content providers."[196]

Problems caused by vertical integration are particularly troubling in communications markets because a communications provider with control over essential physical facilities can exploit its power in more than one market. For example, a local voice service provider with control over physical transmission can provide vertically integrated digital subscriber line (DSL) service, preventing competition from other Internet providers over the same network.[197] At the same time, the company can bundle its voice services with the DSL service. Cable can bundle video with other services. Consumers may be more likely to choose the communications service that can provide for all of their needs, thereby inhibiting competition in the voice market as well. Whether we call them essential facilities,[198] choke points[199] or anchor points,[200] the key leverage point of a communications network is controlling access to facilities.

> The key, after all, is the ability to use "first mile" pipeline control to deny consumers direct access to, and thus a real choice among, the content and services offered by independent providers. Open access would provide a targeted and narrow fix to this problem. AT&T simply would not be allowed to control consumer's ability to choose service providers other than those AT&T itself has chosen for them. This would create an environment where independent, competitive service providers will have access to the broadband "first mile" controlled by AT&T – the pipe into consumers' homes – in order to provide a full, expanding range of voice, video, and data services requested by consumers. The ability to stifle Internet-based video competition and to restrict access to providers of broadband content, commerce and other new applications thus would be directly diminished.[201]

Experts for the local telephone companies, in opposing the merger of AT&T and MediaOne, made this point arguing that "the relevant geographic market is local because one can purchase broadband Internet access only from a local residence"[202] and that "a dominant market share is not a necessary condition for discrimination to be effective."[203] "[A] hypothetical monopoly supplier of broadband Internet access in a given geographic market could exercise market power without controlling the provision of broadband access in neighboring geographic markets."[204]

The essential nature of the physical communication platform was the paramount concern for AT&T long distance in determining interconnection policy for cable networks in Canada.[205] AT&T attacked the claim made by cable companies that their lack of market share indicates that they lack market power, arguing that small market share does not preclude the existence of market power because of the essential function of the access input to the production of service.[206] AT&T further argued that open access "obligations are not dependent on whether the provider is dominant. Rather they are necessary in order to prevent the abuse of market power that can be exercised over bottleneck functions of the broadband access service."[207]

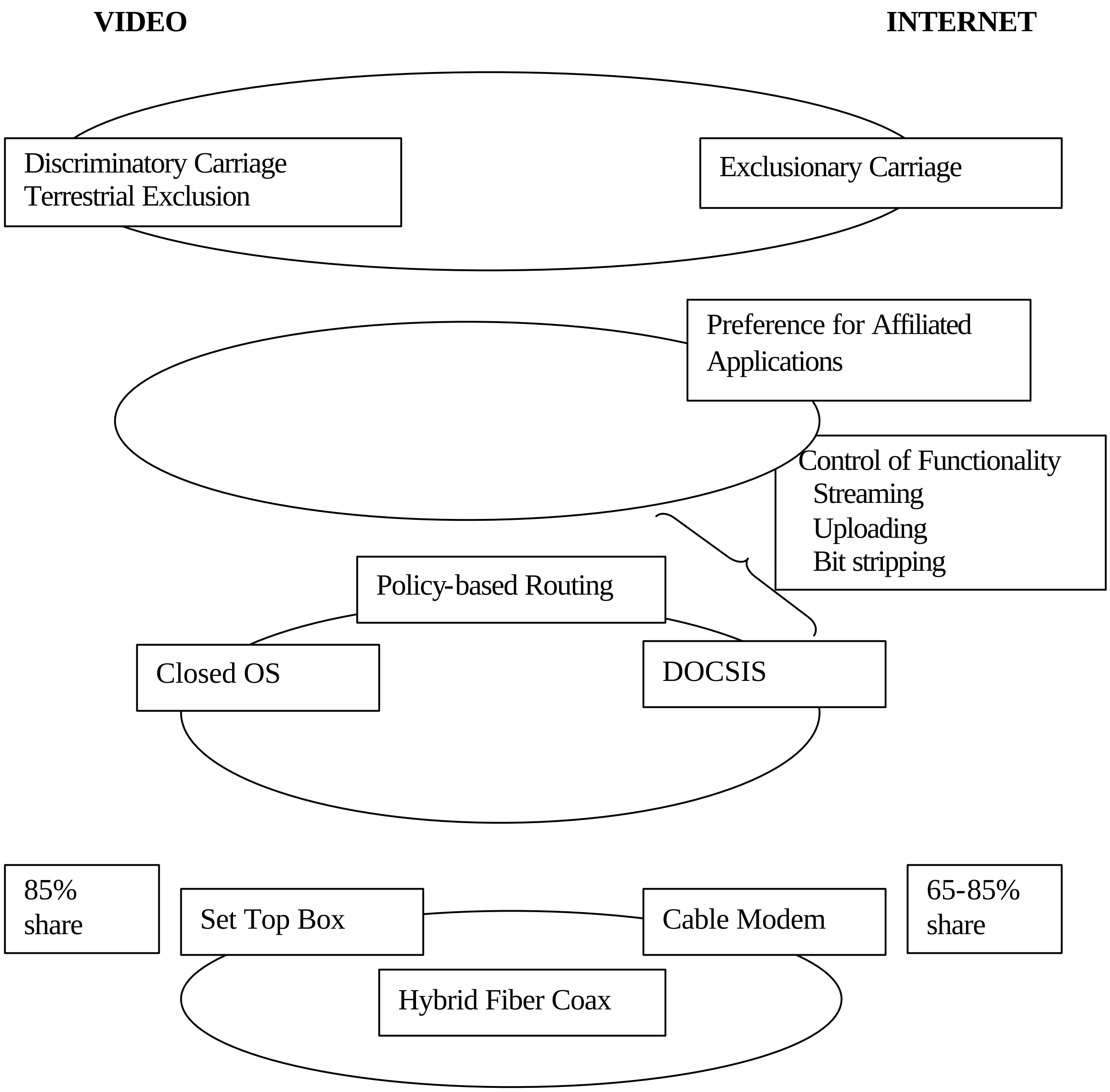
AT&T maintained that the presence of a number of vertically integrated facilities owners does not solve the fundamental problem of access that nonintegrated content providers face, pointing out that since independent content providers will always outnumber integrated providers, competition could be undermined by vertical integration. In order to avoid this outcome, even multiple facilities owners must be required to provide non-discriminatory access.[208] This also applies in the ISP arena. AOL also believed that the presence of alternative facilities did not eliminate the need for open access (see Exhibit IV-2).[209]

Two or three vertically integrated facilities in the broadband arena will not be enough to ensure vigorous competition.[210] It is also important to note the consensus that cable is the dominant and preferred technology.[211] Cable's advantages are substantial, and DSL is not likely to be able to close the gap.[212]

Content discrimination has been the focal point of concern in relation to high-speed Internet services. Content discrimination involves an integrated provider "insulating its own affiliated content from competition by blocking or degrading the quality of outside content."[213] It benefits the vertically integrated entity "by enhancing the position of its affiliated content providers in the national market by denying unaffiliated content providers critical operating scale and insulating affiliated content providers from competition."[214]

AT&T identified four forms of anticompetitive leveraging—bundling, price squeeze, service quality discrimination, and first mover advantage.[215] It describes the classic vertical leveraging tools of price squeezes and quality discrimination as content discrimination. The experts for the local telephone companies identified a similar series of tactics that a vertically integrated broadband provider could use to disadvantage competing unaffiliated content providers.

Exhibit IV- 2: Anti-Consumer/ Anticompetitive Elements Of The Cable Industry Communications Platform



> First, it can give preference to an affiliated content provider by caching its content locally. . . Such preferential treatment ensures that affiliated content can be delivered at faster speeds than unaffiliated content.
>
> Second, a vertically integrated broadband provider can limit the duration of streaming videos of broadcast quality to such an extent that they can never compete against cable programming . . . Third, a vertically integrated firm such as AT&T or AOL-Time Warner could impose proprietary standards that would render unaffiliated content useless. . . Once the AT&T standard has been established, AT&T will be able to exercise market power over customers and those companies trying to reach its customers.[216]

Even after AT&T became the largest cable TV company in the U.S., its long distance division criticized local telephone companies for abusing their monopoly control over their telephone wires. AT&T complained about bottleneck facilities, vertical integration, anticompetitive bundling of services, and the distortion of competition when it opposed the entry of SBC into the long distance market in Texas.[217] These are the very same complaints AOL made about AT&T as a cable company at about the same time.[218] AOL expressed related concerns about the manipulation of technology and interfaces, complaining about "allowing a single entity to abuse its control over the development of technical solutions – particularly when it may have interests inconsistent with the successful implementation of open access… It is therefore vital to ensure that unaffiliated ISPs can gain access comparable to that the cable operators choose to afford to its cable-affiliated ISP."[219]

Long distance companies and competitive local exchange carriers have similar concerns about the merging local exchange carriers. Their experts argued in the proposed SBC-Ameritech and Bell Atlantic-GTE mergers that large size gave network owners an incentive to discriminate. "The economic logic of competitive spillovers implies that the increase in [incumbent local exchange carrier (ILEC)] footprints resulting from these proposed mergers would increase the ILECs' incentive to disadvantage rivals by degrading access services they need to compete, thereby harming competition and consumers."[220]

Wall Street analysts point out that the key to controlling the supply side is controlling essential functions through proprietary standards.[221] Independent ISPs point out that cable operators like AOL use control over functionalities to control the services available on the network.[222] Cable operators have continued to insist on quality of service restrictions by unaffiliated ISPs, which places the ISPs at a competitive disadvantage.[223] Cable operators must approve new functionalities whether or not they place any demands on the network.[224]

Price squeeze and extraction of rents are apparent in the implementation of closed platforms. Thomas Hazlett and George Bittlingmayer cite Excite@Home executive Milo Medin describing the terms on which cable operators would allow carriage of broadband Internet to AOL (before it owned a wire) as follows:

> I was sitting next to [AOL CEO] Steve Case in Congress during the open access debates. He was saying that all AOL wanted was to be treated like

> Excite [@]Home. If he wants to be treated like us, I'm sure he could cut a deal with [the cable networks], but they'll take their pound of flesh. We only had to give them a 75 percent equity stake in the company and board control. The cable guys aren't morons.[225]

In the high speed Internet area, conduit discrimination has received less attention than content discrimination. This is opposite to the considerable attention it receives in the cable TV video service area. Nevertheless, there are examples of conduit discrimination in the high speed Internet market.

In implementing conduit discrimination, the vertically integrated company would refuse to distribute its affiliated content over competing transmission media.[226] In so doing, it seeks to drive consumers to its transmission media and weaken its rival. This is profitable as long as the revenue gained by attracting new subscribers exceeds the revenue lost by not making the content available to the rival. Market size is important here, to ensure adequate profits are earned on the distribution of service over the favored conduit.[227] Although some argue that "the traditional models of discrimination do not depend on the vertically integrated firm obtaining some critical level of downstream market share,"[228] in reality, the size of the vertically integrated firm does matter since "a larger downstream market share enhances the vertically integrated firm's incentive to engage in discrimination."[229]

AT&T has been accused of conduit discrimination in the high speed Internet market.[230] The AOL-Time Warner merger has also raised similar concerns. The significance of AOL's switch to cable-based broadband should not be underestimated. This switch has a powerful effect on the hoped-for competition between cable modems and DSL.[231] Although telephone companies are reluctant to admit that their technology will have trouble competing, their experts have identified the advantages that cable enjoys.[232] Fearing that once AOL became a cable owner it would abandon the DSL distribution channel, the FTC required AOL to continue to make its service available over the DSL conduit.[233]

The focal point of a leveraging strategy is bundling early in the adoption cycle to lock in customers. AOL has also described the threat of vertically integrated cable companies in the U.S.[234] Once AT&T became the largest vertically integrated cable company selling broadband access in the U.S., it set out to prevent potential competitors from offering bundles of services. Bundles could be broken up either by not allowing Internet Service Providers to have access to video customers, or by preventing companies with the ability to deliver telephony from having access to high-speed content. For the Wall Street analysts, bundling seems to be the central marketing strategy for broadband.[235]

AOL argued that requiring open access early in the process of market development would establish a much stronger structure for a pro-consumer, pro-competitive market.[236] Early intervention prevents the architecture of the market from blocking openness, and thus avoids the difficult task of having to reconstruct an open market at a later time.[237] AOL did not hesitate to point out the powerful anticompetitive effect that integrating video services in the communications bundle could have. AOL argued that, as a result of a vertical merger, AT&T would take an enormous next step toward its ability to deny consumers a choice among competing providers of integrated voice/video/data offerings – a communications marketplace that integrates, and transcends, an array of communications services and markets previously viewed as distinct.[238]

Wall Street saw the first mover advantage both in the general terms of the processes that affect network industries, and in the specific advantage that cable broadband services have in capturing the most attractive early adopting consumers.[239] First mover advantages have their greatest value where consumers have difficulty switching or substituting away from the dominant product.[240] Several characteristics of broadband Internet access are conducive to the first mover advantage, or "lock-in."

The local telephone companies have outlined a series of concerns about lock in.[241] High-speed access is a unique product.[242] The Department of Justice determined that the broadband Internet market is a separate and distinct market from the narrowband Internet market.[243] There are switching costs that hinder competition, including equipment (modem) purchases, learning costs, and the inability to port names and addresses. Combining a head start with significant switching costs raises the fear among the independent ISPs that consumers will be locked in. In Canada, AT&T argued that the presence of switching costs could impede the ability of consumers to change technologies, thereby impeding competition.[244]

CONCLUSION

After repeated efforts by telecommunications facility owners to assert control over access to the Internet, it is hard to imagine they will willingly adopt an open architecture. The leverage they enjoy in a blocking technology and the interest they have in related product markets disposes them to maximize profits by maximizing proprietary control over the network. In so doing, they can reduce the competitive threat to their core franchise services and gain advantages in new product markets.[245] "One strategy, which is profitable for a dominant firm but wrecks the benefits of the net, is, for instance, to take advantage of network externalities to 'balkanize' the Internet by reducing connectivity."[246] Facility owners demand a level of vertical control that creates uncertainty about future discrimination, whose mere existence is sufficient to chill innovation.

Faced with the long history of openness and the obvious power of discriminatory access to the communications networks to strangle competition, the defenders of discrimination run through a series of defenses. The owners will voluntarily abandon their proprietary standard and pursue an open architecture. Competition between proprietary standards promotes technological progress and the costs of the proprietary monopoly are smaller than the benefits. Small numbers competition in physical facilities will control rent collection and anti-competitive, antisocial behavior.

V. INTERNET SERVICE PROVIDERS

THE ROLE OF INTERNET SERVICE PROVIDERS IN THE COMMERCIAL SUCCESS OF THE INTERNET

ISPs were the first children of the commercialization of the open network of the Internet and later the first victims of the network foreclosure strategy. ISPs were generally small operators who tied together the broader population of users. Getting 50 million households to use a new, technologically sophisticated device (the PC) to interconnect on a regular basis with a network of millions of other devices was no easy feat.[247] Domestic online service providers numbered about 400 to 500 in the late 1980s when Internet commercialization began (see Exhibit V-1).[248] That number grew to 7,000 to 8,000 ISPs in the late 1990s.[249]

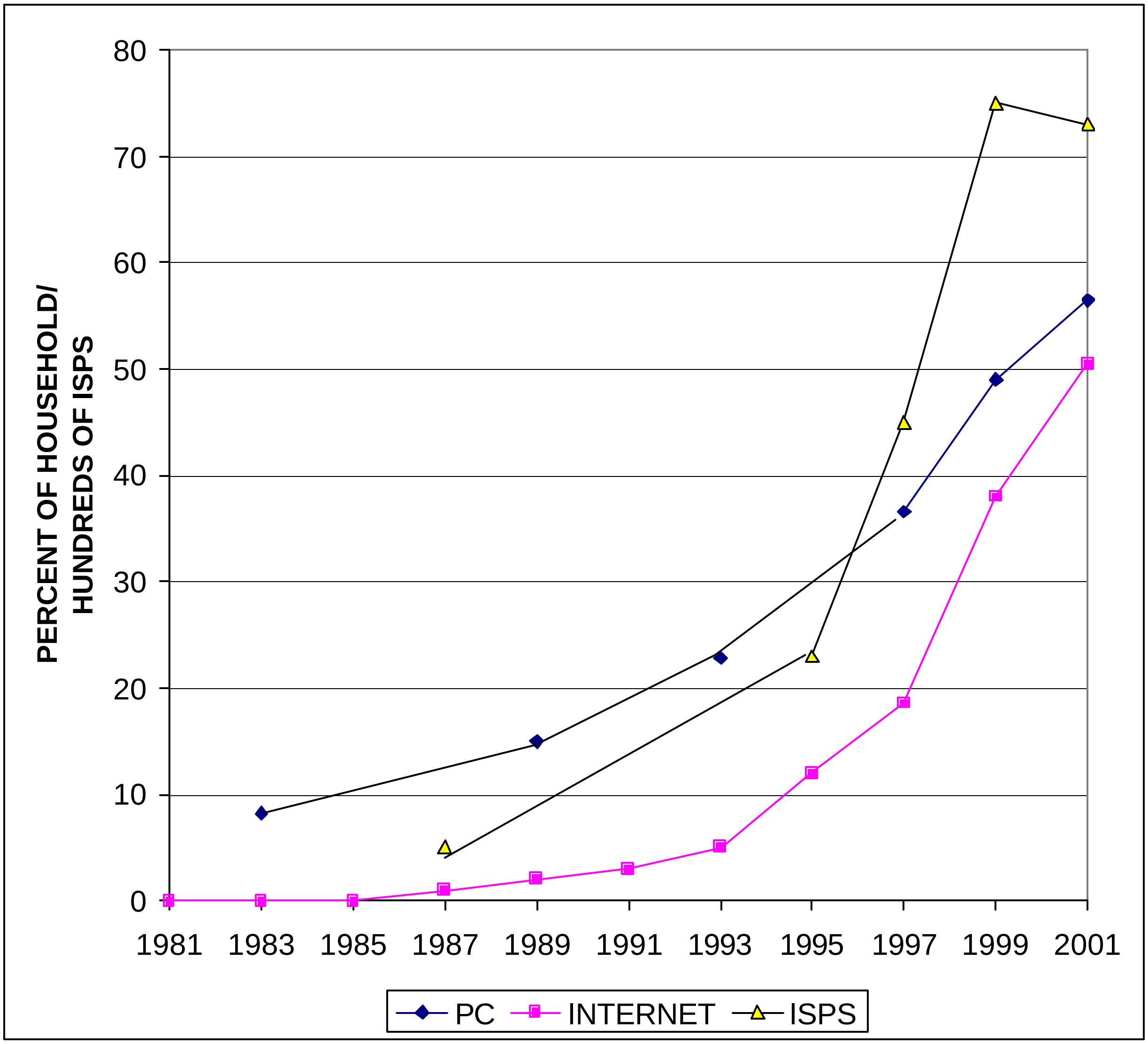
Throughout the history of the commercial narrowband Internet, the number of service providers was never less than 10 per 100,000 customers (see Exhibit V-2). At present, and for most of the commercial history of the industry, there have been 15 or more ISPs per 100,000 subscribers on the open, dial-up Internet.

Buying wholesale telecommunications service from telephone companies and selling basic Internet access combined with a variety of additional applications and services to the public, they translated the complex technologies that had to be combined to use the Internet into a mass market service.[250] Once the Internet was commercialized, ISPs rapidly covered the country with dial-up access and translated a series of innovations into products and services that were accessible and useful to the public. Berners-Lee noted the critical linking role played by ISPs:

> It was already possible for anyone to download, free, all the browsers, TCP/IP, and software needed to get on the Internet and Web, but a user had to know a lot about how to configure them and make them work together, which was complicated. Neither the Internet nor the Web had initially been set up for home or individual business use; they were meant for universities, researchers and large organizations…
>
> Soon thereafter, however, many Internet service providers started to spring up – local companies that would give access to the Internet via a local telephone call. They provided all the software a subscriber required.[251]

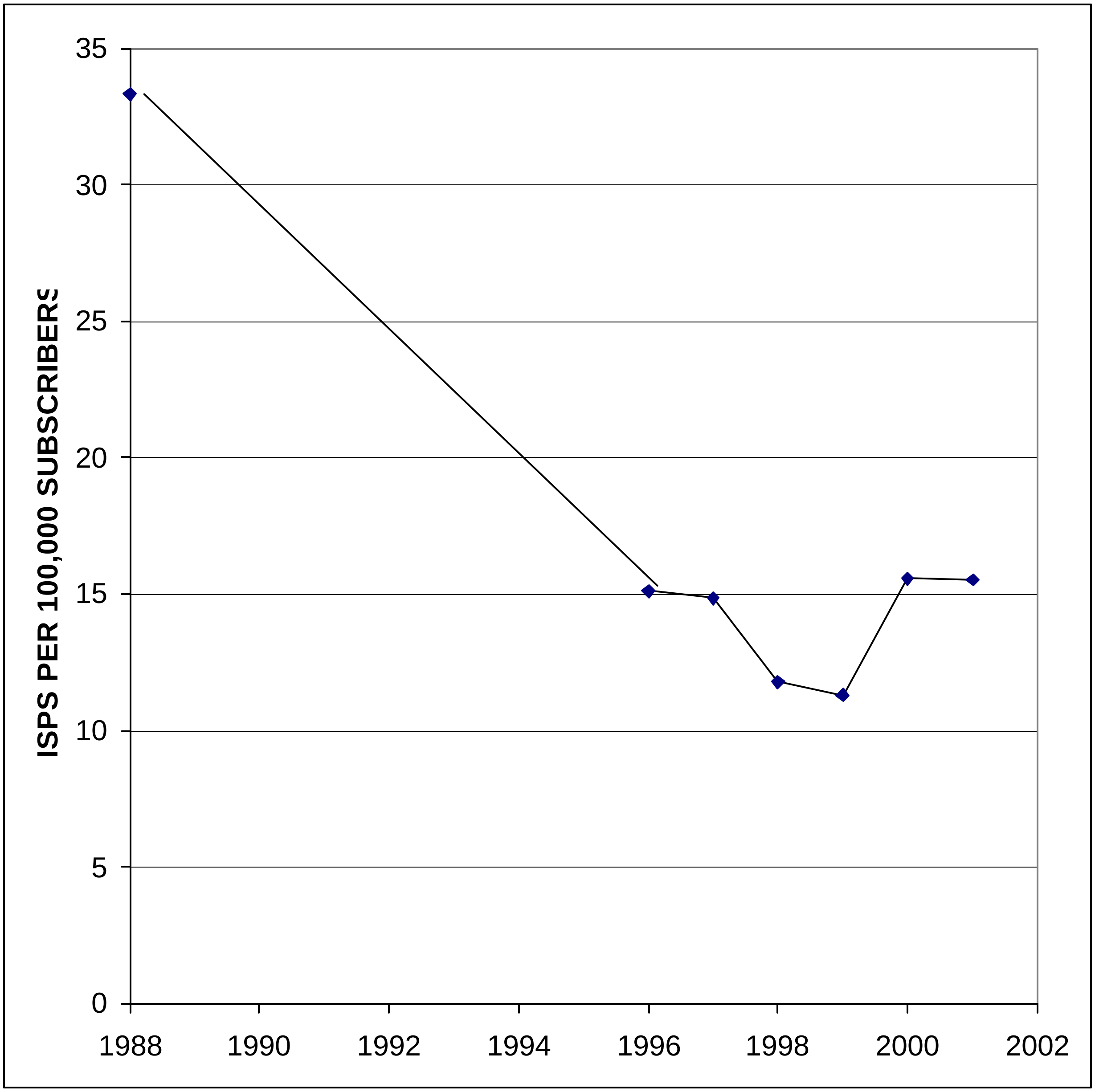
Greenstein analyzes the activities of ISPs as "coinvention, the complementary invention that makes advances in general purpose technology valuable in particular places at particular points in time."[252] Some of the underlying innovations that the ISPs adapted and popularized had been around for a while, like the Internet protocol itself, e-mail, file transfer and sharing, and bulletin boards. Some of the innovations were very recent, like the web, the browser, instant messaging and streaming.

Exhibit V-1: ISPS, Internet Subscription And Home PC Penetration



Source: Carey, John, "The First Hundred Feet for Households: Consumer Adoption Patterns," in Deborah Hurley and James H. Keller (Eds.), *The First Hundred Feet* (Cambridge: MIT Press, 1999); National Telecommunications Information Administration, *A Nation Online* (U.S. Department of Commerce, 2002). Early ISP counts are discussed in Cooper, Mark, *Expanding the Information Age for the 1990s: A Pragmatic Consumer View* (Washington, D.C.: Consumer Federation of America, American Association of Retired Persons, January 11, 1990); see also Abbate, Janet, *Inventing the Internet* (Cambridge: MIT Press, 1999) and Matos, F., *Information Service Report* (Washington, D.C.: National Telecommunications Information Administration, August 1988). Recent ISPS Counts are from *Boardwatch Magazine*, "North American ISPS," mid-year estimates. For high speed ISPs see Federal Communications Commission, *High-Speed Services for Internet Access*," various issues.

Exhibit V-2: Density Of Internet Service Providers By Date



Source: Subscriber counts: Carey, John, "The First Hundred Feet for Households: Consumer Adoption Patterns," in Deborah Hurley and James H. Keller (Eds.), *The First Hundred Feet* (Cambridge: MIT Press, 1999); National Telecommunications Information Administration, *A Nation Online* (U.S. Department of Commerce, 2002). Early ISP counts are discussed in Cooper, Mark, *Expanding the Information Age for the 1990s: A Pragmatic Consumer View* (Washington, D.C.: Consumer Federation of America, American Association of Retired Persons, January 11, 1990); see also Abbate, Janet, *Inventing the Internet* (Cambridge: MIT Press, 1999 and Matos, F., *Information Service Report* (Washington, D.C.: National Telecommunications Information Administration, August 1988). Since the mid-1990s, annual counts of ISPs have been published in *Boardwatch*. Recent ISP counts are from *Boardwatch Magazine*, "North American ISPS," mid year estimates. For high speed ISPs, see Federal Communications Commission, *High-Speed Services for Internet Access*" (Washington, D.C., various issues).

Greenstein argues that "[a] significant set of activities of many providers in the commercial Internet market involved 'adaptation… Adaptation does not happen on its own."[253] The process involves "one of several activities: Monitoring technical developments, distilling new information into components that are meaningful to unfamiliar users, and matching unique user needs to one of the many possible solutions."[254]

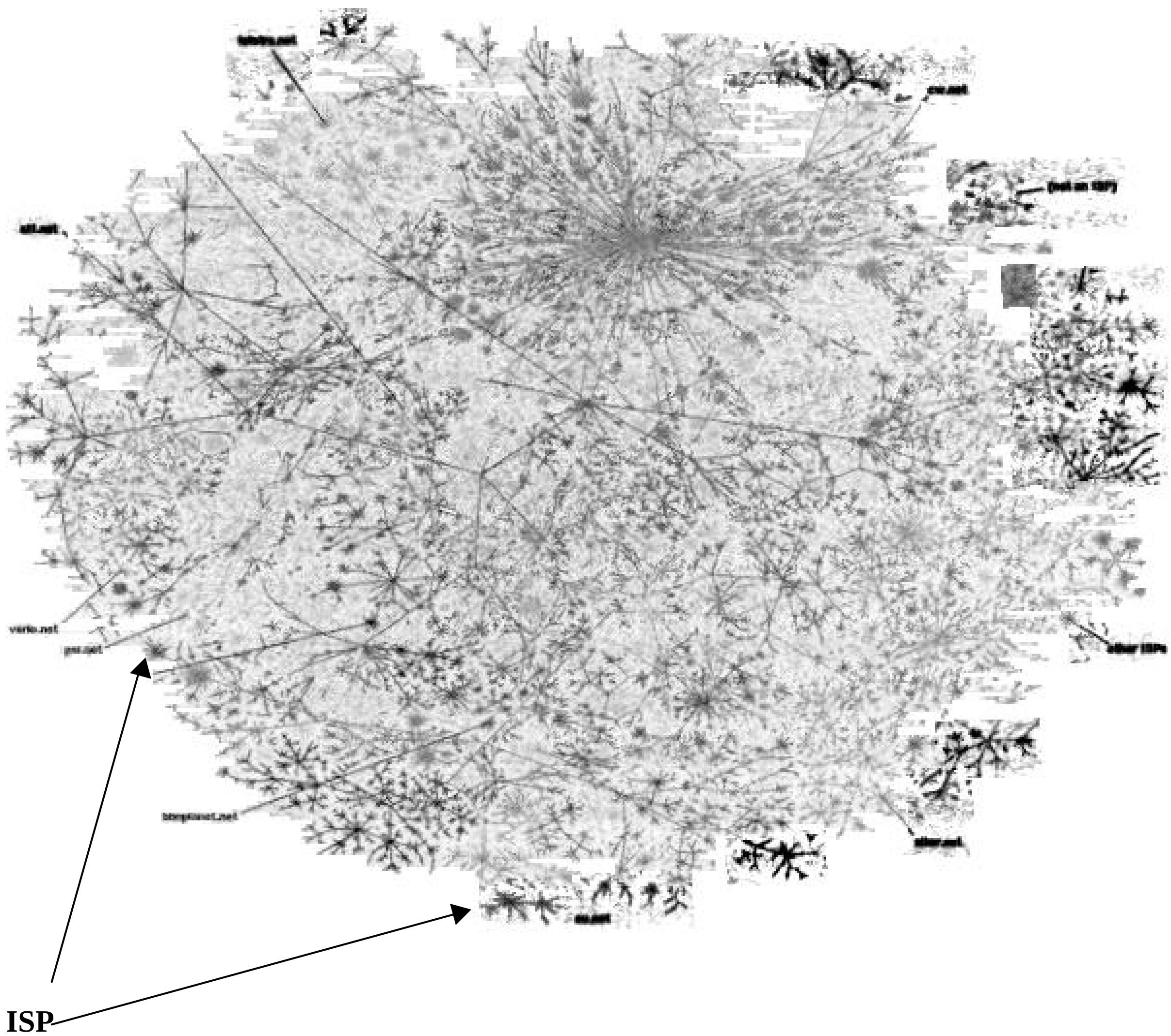
Local specificity and the importance of the linking and communications function of ISPs is strong because adaptation "depends on the users, their circumstances, their background, their capital investments, the costs of adjusting to new services, and other factors that influence the match between user needs and technological possibilities."[255] Consequently, there were few plain vanilla ISPs, offering only basic access to the Internet. Thousands of ISPs tailoring services to customer needs supported the rapid spread of Internet subscription and use. Greenstein finds that "by the summer of 1998… there were dozens of well-known national networks and scores of less-known national providers covering a wide variety of dial-up and direct access. There were also thousands of regional and local providers of Internet access that served as the link between end-users and the Internet backbone."[256]

Exhibit V-3 shows a map of the Internet based on data collected in June of 1999. That moment was probably the height of density of ISPs per subscriber. The commercial Internet was still almost entirely based on dial-up service. The small clusters in the Exhibit represent ISPs, which provide the connectivity to the Internet. A few of the larger ISPs are labeled, but most are relatively small. The other characteristics of the network are also evident. We see hubs typified by preferential attachment and hierarchy in a decentralized and distributed architecture.

In the view of some, the impact of "the army of ISPs" goes beyond merely spurring the adoption of Internet service on the demand side. They opened markets that were neglected by dominant ISPs and forced dominant firms to make services available that they might well have resisted had they not faced the competition. Competition at the level of service providers not only drove adoption but also stimulated cross layer competition. David Mowery and Timothy Simcoe describe these impacts as follows:

> These small ISPs benefited from the distance-sensitive pricing of long distance telecommunication services that created opportunities for entry by ISPs into local markets, the focus of larger ISPs on high-density urban locations and the fact that no more than a few hundred customers were needed to provide sufficient revenues to fund a modem pool and high-speed connection. At the same time, many of the larger online services hesitated to provide unrestricted Internet access, which they saw as diluting the value of their proprietary applications. In a classic illustration of the power of network externalities, the rising number of Internet hosts and users compelled the major online service providers to offer e-mail connectivity and later, browsing, in order to keep their customers…

Exhibit V-3: A Map Of The Internet, Mid-1999



Source: Buchanan, Mark, *Nexus: Small Worlds and the Groundbreaking Theory of Networks* (New York: Norton, 2002), p. 81; Reprint of Burch/Cheswick Map of the Internet.

> Increased demand and entry by new service providers led to rapid investment in new capacity, particularly in major metropolitan areas, and brought telecommunications service providers into direct competition with national and regional ISPs… The PC networks that evolved from bulletin boards into online service providers were a significant source of Internet growth and competition in the market for access.[257]

Interestingly, a close look at the data suggests that the Internet, delivering access to the Worldwide Web rendered accessible by the development of web browsers, became the killer application for the PC (see Exhibit V-4). Although the PC had enjoyed success prior to commercialization of the Internet, it was only after the advent of selling Internet access service to the public that PC sales exploded.

PC prices played a role as well, but it can be argued that the demand stimulation created by the killer application laid the groundwork for the price reductions (see Exhibit V-5). The initial PC price reduction of the mid-1980s sustained moderate growth of the PC for about a decade. In the mid-1990s, PC prices were stable, as Internet use escalated. In the late 1990s, PC prices came down, as demand and Internet use grew. Thus, in an important way, the application that triggered demand contributed to the cycle of economies of scale that is so important in the computer industry.

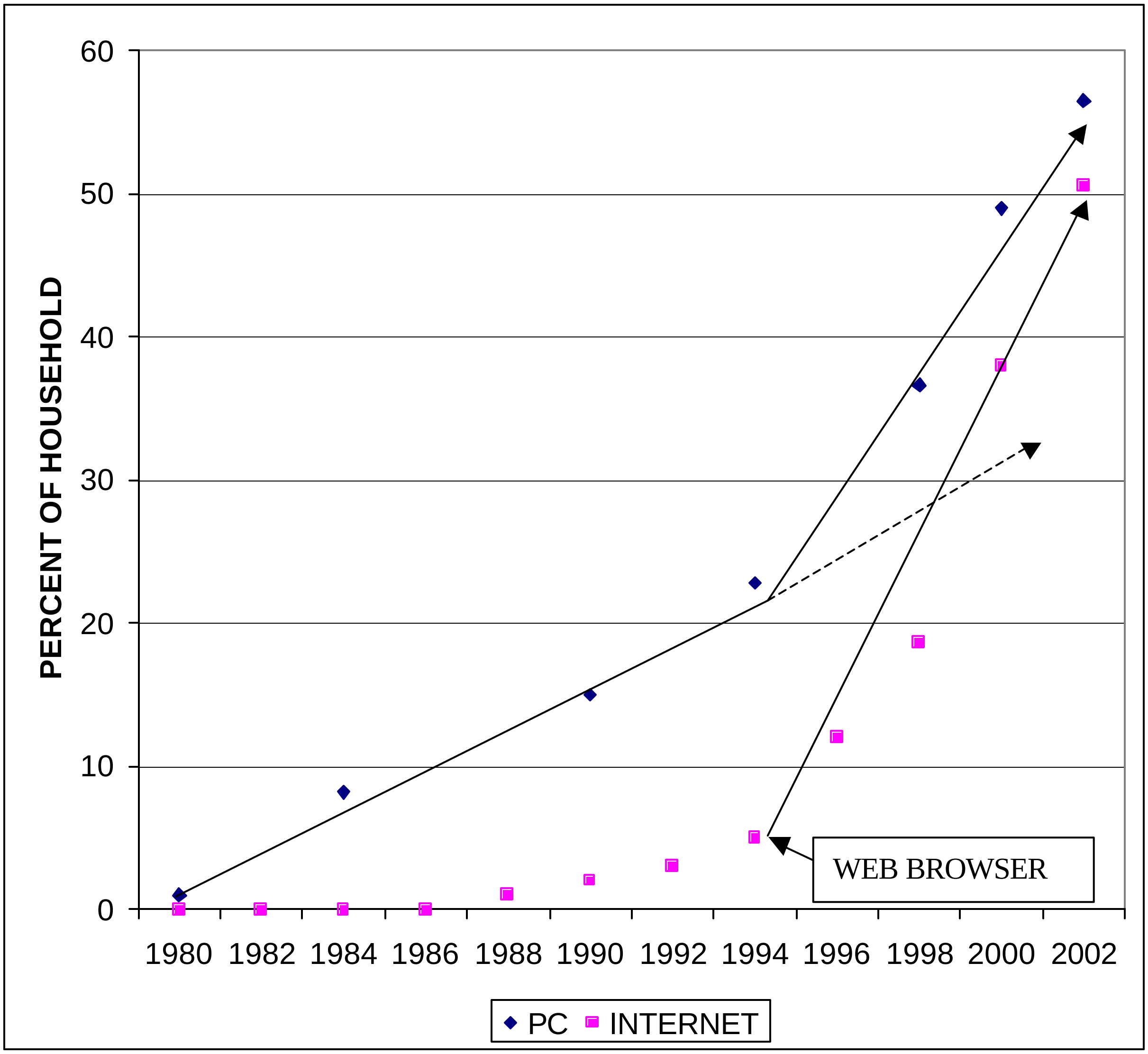
The competitive pressures that small ISPs brought to the Internet service market and the investment in complementary communications equipment stimulated by having nondiscriminatory access to the network represents a general pattern that can be expected to be repeated. In fact, a similar process can be seen in the development of competitive local exchange carriers. In an effort to stimulate competition in telecommunications markets, Congress mandated that the CLECs be given access to the elements that constitute the telephone network in an unbundled fashion. These entities began by innovating in marketing and customer service as the ISPs had done, specializing in:

> the value added a competitor contributes through steps such as definition, marketing, sales, and support of commercialized services, all dimensions around which competitors seek to compete and innovate….In the case of UNE-P, for example, competition is keen in pricing, brandings, markets, customer service, etc… [T]hose activities constitute real competition that results in true economic efficiency.[258]

Although the marketing innovation of the new entrants is most obvious, they have also made substantial contributions to the production side of the industry. They have driven innovation in operating support and back office systems, rights of way and collocation, and the provisioning and use of fiber.

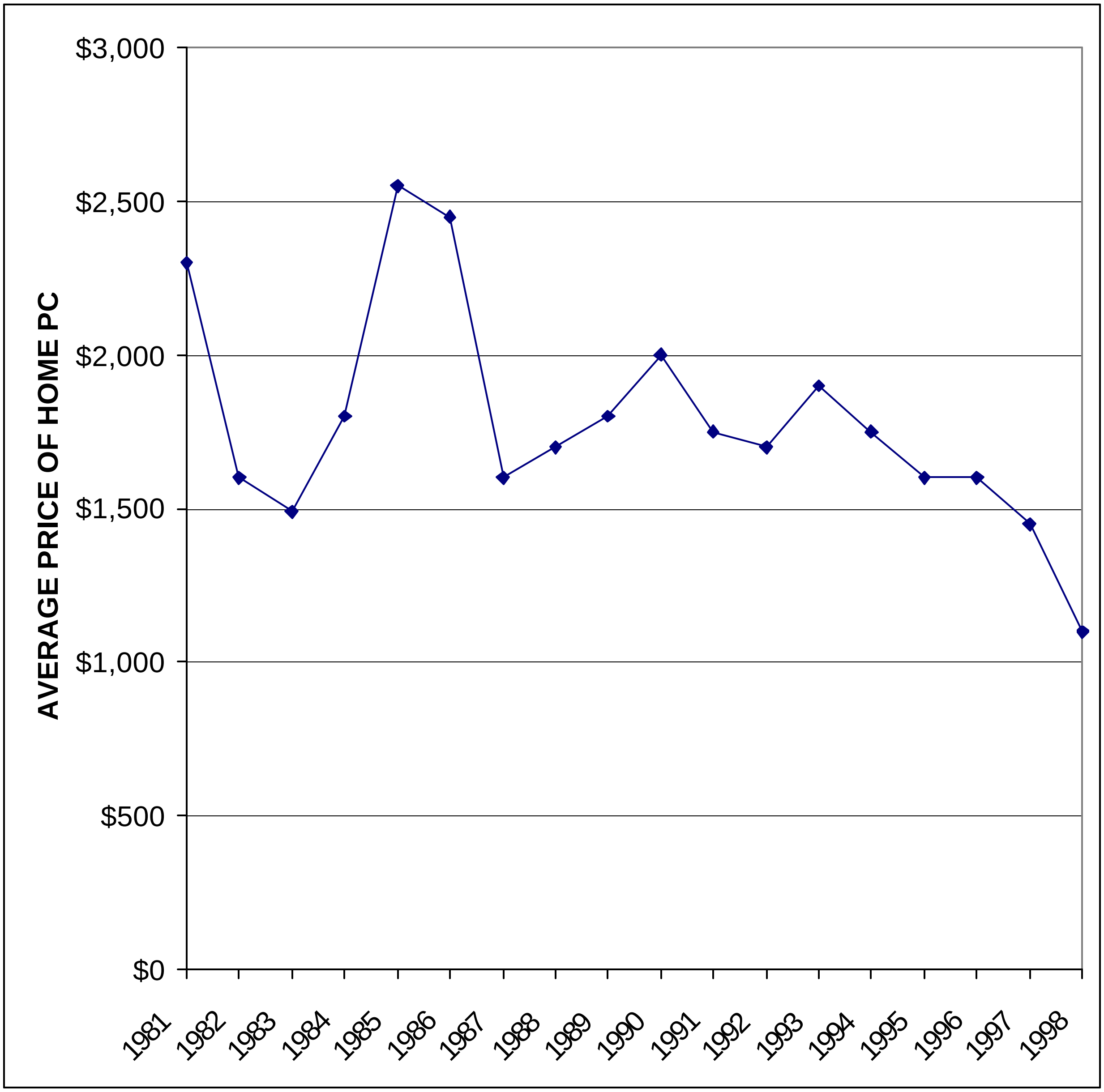
> Entrants innovated in almost every dimension of the business from use of rights-of-way, to becoming early adopters of new technology. Entrants innovated at the OSS/BSS level by working closely with new vendors that were developing modular off-the-shelf elements that would support a plug-

Exhibit V-4: The Internet And The Web Were 'Killer Apps" For The PC



Source: Carey, John, "The First Hundred Feet for Households: Consumer Adoption Patterns," in Deborah Hurley and James H. Keller (Eds.), *The First Hundred Feet* (Cambridge: MIT Press, 1999); National Telecommunications Information Administration, *A Nation Online* (U.S. Department of Commerce, 2002). Early ISP counts are discussed in Cooper, Mark, *Expanding the Information Age for the 1990s: A Pragmatic Consumer View* (Washington, D.C.: Consumer Federation of America, American Association of Retired Persons, January 11, 1990); see also Abbate, Janet, *Inventing the Internet* (Cambridge: MIT Press, 1999) and Matos, F., *Information Service Report* (Washington, D.C.: National Telecommunications Information Administration, August 1988).

Exhibit V-5:Average Price Of Home Personal Computers



Source: Carey, John, "The First Hundred Feet for Households: Consumer Adoption Patterns," in Deborah Hurley and James H. Keller (Eds.), *The First Hundred Feet* (Cambridge: MIT Press, 1999), p. 41.

> and-play strategy. While incumbents were selling their real estate because of the miniaturization of equipment and complaining that there was not enough space for collocation, entrepreneurs created the *telehouse,* where myriad service providers could collocate and interconnect efficiently. Fiber became commercialized under a growing diversity of formats – dark or lit, by strands or lambda. While ADSL had been developed by Bellcore in the late 1980's, the CLECs were the first to push for its large-scale deployment. In all, entrants brought a new standard of innovation and efficiency to the marketplace.[259]

> One of the lessons from the recent competitive era is that new entrants and competitors can be quite ingenious and innovative in tackling the challenges that they face. One of the most impressive innovations was the use of old pipelines to create a national backbone fiber network… More generally entrants have been very successful in addressing the right-of-way problem where they were at an enormous disadvantage.[260]

Thus, the introduction of competition in a middle or applications layer not only promotes efficiency in that layer, but it may provide the base for launching competition across layers, as well as stimulating investments in complementary assets.

THE MONOPOLIZATION OF THE HIGH-SPEED INTERNET

The high degree of control and foreclosure of the broadband platform was encapsulated in a term sheet offered by Time Warner to Internet Service Providers. Time Warner sought to relieve the severe pressures of a merger review before policymakers had officially abandoned the policy of nondiscrimination by offering to allow unaffiliated ISPs to compete for Internet access service over their last mile facilities. Complete foreclosure was to be replaced with severe discrimination. There in black and white are all the levers of market power and network control that stand to stifle innovation on the Internet. Time Warner demanded the following:

(1) Prequalification of ISPs to ensure a fit with the gatekeeper business model

(2) Applying ISPs must reveal sensitive commercial information as a precondition to negotiation

(3) Restriction of interconnecting companies to Internet access sales only, precluding a range of other intermediary services and functions provided by ISP to the public (e.g. no ITV [interactive TV] functionality)

(4) Restriction of service to specified appliances (retarding competition for video services)

(5) Control of quality by the network owner for potentially competing video services

(6) Right to approve new functionalities for video services

(7) A large nonrefundable deposit that would keep small ISPs off the network

(8) A minimum size requirement that would screen out niche ISPs

(9) Approval by the network owner of the unaffiliated ISP's home page

(10) Preferential location of network owner advertising on all home pages

(11) Claim by the network owner to all information generated by the ISP

(12) Demand for a huge share of both subscription and ancillary revenues

(13) Preferential bundling of services and control of cross marketing of services

(14) Applying ISP must adhere to the network operator's privacy policy.[261]

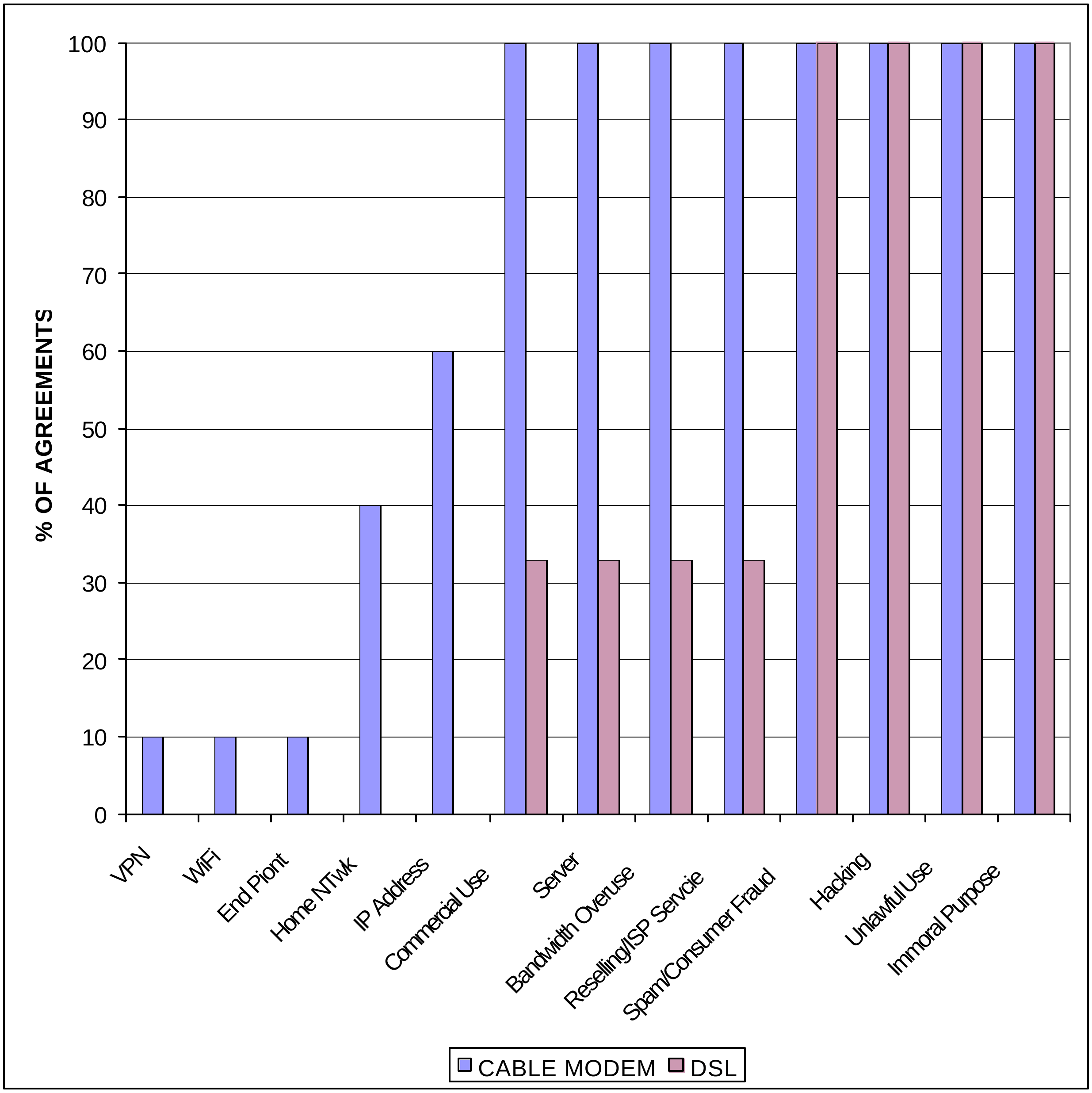
Under these conditions, the commercial space left for the unaffiliated and smaller ISPs is sparse and ever shrinking.[262] It took tremendous courage to put the term sheet in the public record in violation of the nondisclosure agreements that Time Warner had demanded,[263] especially in light of the threats and actions that the dominant cable operators have hurled at those who challenge their proprietary plans.[264] At one time or another these "conditions" were written into a contract with a service provider or a consumer service agreement or were implemented in the network (see Exhibit V-6).

In comments at the Federal Communications Commission, the High Tech Broadband Coalition noted "troubling evidence of restrictions on broadband consumers' access to content, applications and devices."[265] From the point of view of the technical design features of the Internet that unleashed the dynamic forces of innovation, the fact that these negotiations must take place at all is the truly chilling proposition.

The largest ISP, AOL, capitulated to the cable monopolists as part of the effort to untangle its holdings with AT&T, which was being acquired by Comcast. After a five-year struggle for carriage, AOL signed a three-year contract for access to less than one-half of Comcast's[266] lines under remarkably onerous conditions.[267] AOL agreed to pay $38 at wholesale for a service that sells for $40 in the cable bundle. It allowed Comcast to keep control of the customer and to determine the functionality available. It apparently agreed to a no–compete clause for video. As AOL put it, the deal turned the high-speed Internet into the equivalent of a premium cable channel, like HBO. Nothing could be farther from the Internet as it was.

Why did AOL agree? It was desperate for carriage. You cannot be a narrowband company in a broadband world, and DSL just does not cut it. The AOL-Comcast agreement punctuates a seven-year policy of exclusion. The deal with Comcast only allowed AOL to negotiate with the individual cable franchises for carriage, but AOL never reached the specific agreements that are necessary to actually deliver service to consumers. Ultimately AOL gave up on the approach.[268] Although telephone companies ostensibly have been required to provide access to their advanced telecommunications networks, they have made life miserable for the independent ISPs.[269] A major source of potential discrimination lies in the architecture of the network. The technical capabilities of the network controlled by the proprietor can be configured and operated to disadvantage competitors.

Exhibit V-6: Restrictive Conditions In High Speed Internet Consumer Contracts



Source: Wu, Tim, "Network Neutrality, Broadband Discrimination, *Journal on Telecommunications & High Technology Law*, 2:1, 2003.

ISPs have identified a range of ways the dominant telephone companies impede their ability to interconnect in an efficient manner. The proprietary network owner can seriously impair the ability of competitors to deliver service by restricting their ability to interconnect efficiently and deploy or utilize key technologies that dictate the quality of service. Forcing independent ISPs to connect to the proprietary network or operate in inefficient or ineffective ways or giving affiliated ISPs preferential location and interconnection can result in substantial discrimination. Similarly, forcing competitive local exchange carriers to make digital to analog to digital conversions to implement cross connects raises costs. The result is a sharp increase in the cost of doing business or degradation of the quality of service.

Refusing to peer with other ISPs and causing congestion by "deliberately overloading their DSL connections by providing them with insufficient bandwidth from the phone company's central offices to the Internet"[270] create a roadblock that forces ISPs to enter into expensive transport arrangements for traffic.[271] Refusing to guarantee quality of service to unaffiliated ISPs and imposition of speed limits[272] has the effect of restricting the products they can offer.[273] The network owners then add insult to injury by forcing ISPs to buy bundles of redundant services,[274] preventing competitors from cross connecting to one another,[275] restricting calling scopes for connection to ISPs,[276] and refusing to offer a basic service arrangement or direct connection to the network.[277] The effect is to undermine competition and restrict service offerings.[278]

The most critical architectural decisions are to impose network configurations that prevent competition for the core monopoly service, voice.[279] This bundling of competitive and noncompetitive services places competitors at a disadvantage.[280] Ironically, Cox complains that it is being discriminated against when incumbent telephone monopolists bundle voice and data, while it pursued a similar exclusionary tactic with respect to the bundling of video and data.[281] Independent ISPs have pointed out that their ability to offer voice is being frustrated by architectural decisions that deny them the ability to offer the voice/data bundle.[282] Moreover, incumbents are reserving the right to offer additional services, like video, over lines for which independent ISPs are the Internet access service provider.[283]

The price squeeze that AOL was subject to in its agreement with Comcast was similar to that imposed by both the cable modem and DSL network owners. The price for access to the network is far above costs and leaves little margin for the unaffiliated ISP.[284] The margins between the wholesale price ISPs are forced to pay and the retail price affiliated ISPs charge are as small as $1 on the telephone network.[285] For cable networks, the margins are as low as $5. In other words, independent ISPs are forced to look at margins in the single digits and never much above 20 percent. Cable and telephone company margins for these services are well in excess of 40 percent.[286]

Consumers pay a price too. With costs falling[287] and demand lagging in the midst of a recession, both cable operators and telephone companies raised prices. Cable companies imposed a severe interruption of service on their customers, which, in a highly competitive market, would have been suicidal.[288] In 2003, Comcast, the dominant high-speed modem service provider, raised the price of stand-alone cable modem service by $10 to $15 per month. In 2003, some of the Bell companies offered discounts, but the cable companies refused to respond to telephone company pricing moves. DSL service is not competitive on price on a megabit basis. Since DSL cannot compete on a quality-adjusted basis, the cable operators ignore it. Their advertising harps on their speed superiority. With the dominant technology insulated from cross-technology competition and operating a closed network, cable companies have strategically priced their digital services. This becomes quite apparent to any consumer who tries to buy the service in the marketplace. If a consumer adds a digital tier, the charge would be an additional $15 on average. If a consumer adds cable modem service, the consumer must pay $45 ($55 to $60 if basic cable is not taken). Moreover, if the consumer wants to keep an unaffiliated ISP, the charge is an additional $15. The resulting price is too high and dampens adoption.

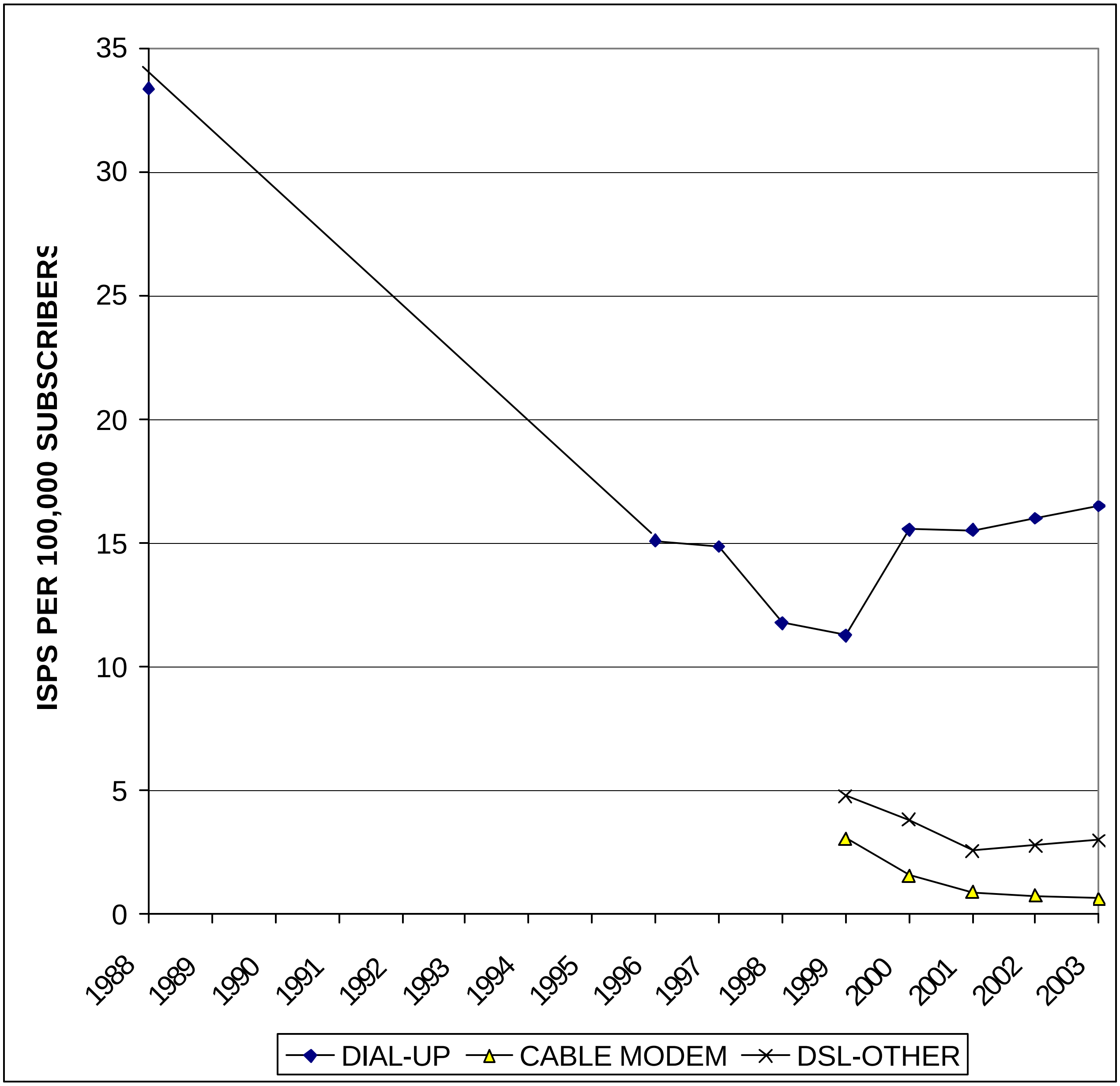
SQUEEZING INTERNET SERVICE PROVIDERS OUT OF THE MARKET

ISPs were the first victims of the network foreclosure strategy. The results of the closure of advanced telecommunications services are becoming clear. The independent business of buying telecommunications services and selling Internet access service has been all but eliminated from the high-speed Internet market by the withholding of advanced telecommunications services. In contrast to the 15 ISPs per 100,000 customers on the dial-up Internet, on the high-speed Internet there are now fewer than 2 ISPs per 100,000 customers (see Exhibit V-7). For cable modem service there is less than 1 Internet service provider per 100,000 customers. For DSL service, there are fewer than 2.5 ISPs per 100,000 customers. Viewed on a market size basis, the impact is even starker (see Exhibit V-8).

The foreclosure of the market to independents is even more profound than these numbers indicate. Approximately 95 percent of high-speed Internet access service customers are served by ISPs affiliated with either cable companies or telephone companies.[289] This dominance is not the result of winning in a competitive market; it is the result of leveraging control of physical facilities. The fact that control over the wires is the cornerstone of this market foreclosure is demonstrated by the failure of the cable and telephone affiliated ISPs to have any success in the truly competitive narrowband Internet market. Cable companies have not sold Internet service in any product and geographic market where they do not control a monopoly wire. Telephone companies have done very poorly as ISPs in the dial-up market. Consequently, 95 percent of the customers in the dial-up market take their service from independent ISPs – treating AOL as an independent in the dial-up market. In other words, incumbent monopolists have a 95 percent market share where they can leverage their market power over their wires, and a 5 percent market share where they cannot.

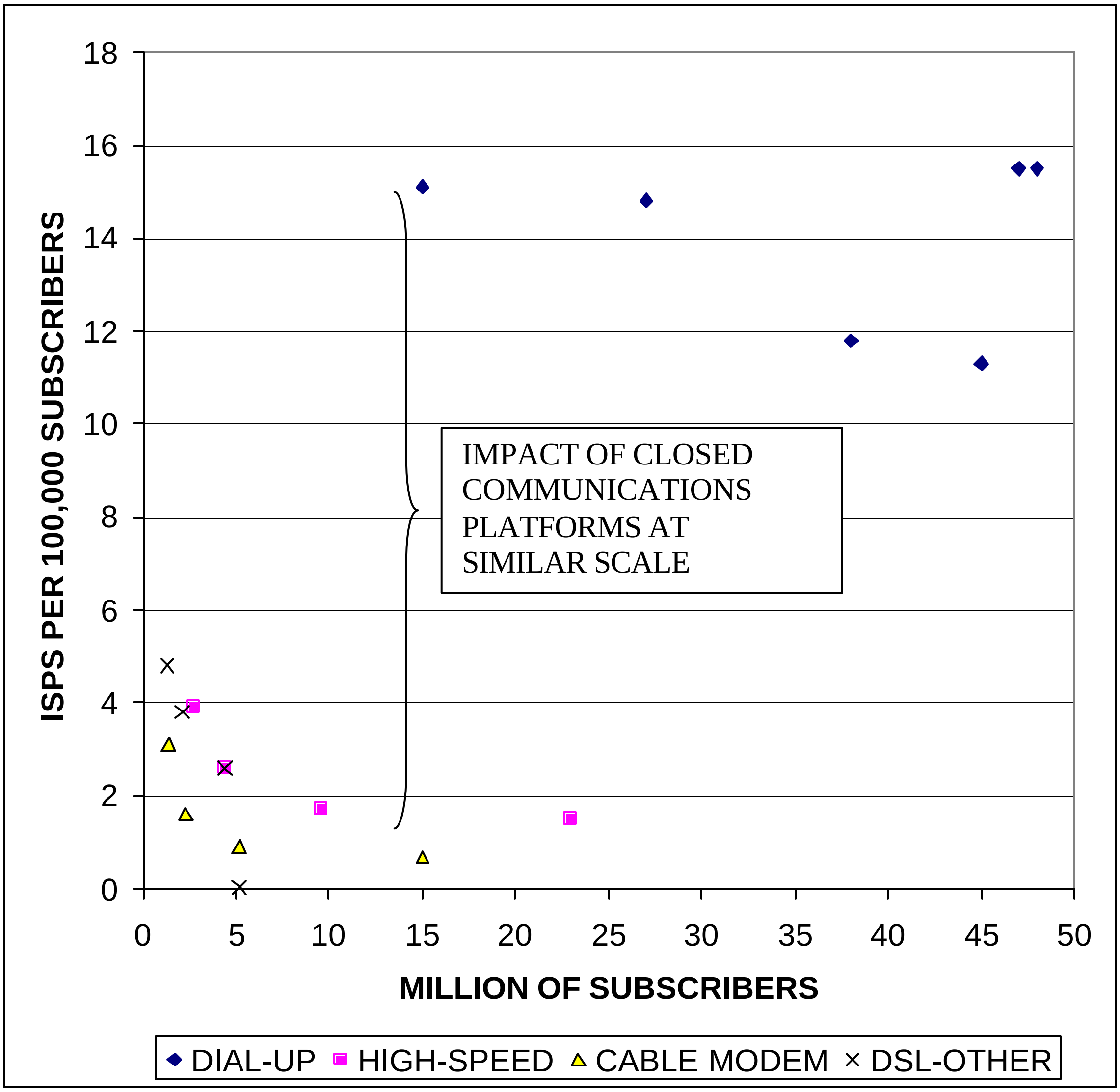
It may well be that the Internet service market was due for some consolidation.[290] However, the staying power of ISPs is impressive. One recent count found that after taking into account the largest 23 ISPs, all of whom had 200,000 or more users, the "other U.S. ISPs" still accounted for 57 percent of Internet users in the U.S.[291] Focusing on the dial-up market, after the largest ISPs (ten in all) were taken into account, the "other U.S. ISPs" accounted for over 62 percent of the total. In the high-speed Internet, there are virtually no "other U.S. ISPs."

Exhibit V-7: Density Of Dial-Up And High-Speed ISP By Date



Source: Subscriber counts: Carey, John, "The First Hundred Feet for Households: Consumer Adoption Patterns," in Deborah Hurley and James H. Keller (Eds.), *The First Hundred Feet* (Cambridge: MIT Press, 1999); National Telecommunications Information Administration, *A Nation Online* (U.S. Department of Commerce, 2002). Early ISP counts are discussed in Cooper, Mark, *Expanding the Information Age for the 1990s: A Pragmatic Consumer View* (Washington, D.C.: Consumer Federation of America, American Association of Retired Persons, January 11, 1990). See also Abbate, Janet, Inventing the Internet (Cambridge: MIT Press, 1999) and Matos, F., *Information Service Report* (Washington, D.C.: National Telecommunications Information Administration, August 1988), p. x. More recent numbers are from the Bureau of Labor Statistics; 2001b. Since the mid-1990s, annual counts of ISPs have been published in *Network World*.

Exhibit V-8: Density Of Dial-Up And High Speed ISPs By National Market Size



Source: Subscriber counts: Carey, John, "The First Hundred Feet for Households: Consumer Adoption Patterns," in Deborah Hurley and James H. Keller (Eds.), *The First Hundred Feet* (Cambridge: MIT Press, 1999); National Telecommunications Information Administration, *A Nation Online* (U.S. Department of Commerce, 2002). Early ISP counts are discussed in Cooper, Mark, *Expanding the Information Age for the 1990s: A Pragmatic Consumer View* (Washington, D.C.: Consumer Federation of America, American Association of Retired Persons, January 11, 1990). See also Abbate, Janet, Inventing the Internet (Cambridge: MIT Press, 1999) and Matos, F., *Information Service Report* (Washington, D.C.: National Telecommunications Information Administration, August 1988), p. x. More recent numbers are from the Bureau of Labor Statistics; 2001b. Since the mid-1990s, annual counts of ISPs have been published in *Network World*.

The closing of the Internet produces a very different picture of service development and innovation than we saw on the dial-up Internet. In contrast to the dial-up Internet, which witnessed a steady flow of innovations and the growth of a large customer service sector that stimulated the adoption of Internet service by a majority of households, the broadband Internet is a wasteland. The body of potential innovators and customer care providers has shrunk. At a minimum, ISPs provided customer care, extended service throughout the country and adapted applications to customer needs. They are like the mechanics and gas stations in the automobile industry. There are now just too few ISPs on the broadband Internet.

A small number of entities dominating the sale of high-speed Internet access and dictating the nature of use is the antithesis of the environment in which the narrowband Internet was born and enjoyed such rapid growth. Changing the environment changes the nature of activity. One thing we never heard about the narrowband Internet was a complaint about the slowness of innovation. High-speed service is into its seventh year without a major innovation to drive adoption. Complaints about high prices for high-speed Internet have come earlier and louder than they did for narrowband service.

The Internet model has been turned on its head in the closed broadband space. Analysts proclaim critical mass of deployment and wait for the killer application, while they worry about how average users will be induced to adopt services.

> With close to 27 million US business and residential subscribers at the end of 2003, broadband is now clearly a mainstream service… However, the one major challenge that faces the future provisioning of broadband will come from a less tech-savvy subscriber. As broadband moves into mass adoption, newer subscribers will be less experienced with computers and the Internet. They will expect all of the benefits of the Internet, but will have less patience for dealing with its technical issues.[292]

That was exactly the function of the ISPs that have been decimated by the denial of access to customers. More importantly, Internet applications did not wait for a subscriber base, they drove demand for subscription. The potential applications that are expected to flourish have run into problems with the closed platform. "[T]he existence of a significant subscriber base opens up markets for other services that are looking to take advantage of the broadband connection, such as home entertainment/networking, Voice over IP (VOIP) and online gaming."[293] Home networking and entertainment, as well as online gaming have been possible for several years, but have been resisted by cable operators who want to control them. VOIP, which relies more on the "always on" characteristic of the broadband platform, is still confronted with questions of proprietary restrictions.

> [A] spokesman for cable broadband provider Cox Communications agreed that VOIP can be a crapshoot depending on what broadband provider you have. "People should keep in mind that VOIP from companies not offering their own broadband is only a 'best effort' service."

> Cox offers a VOIP service over its own broadband network. According to Amirshahi, the company goes to great pains to ensure its own VOIP customers' traffic stays on its own network, where problems can be acted on very quickly.[294]

Thus, the hoped for uplift in services and adoption is still hampered by the obstacles that the open Internet architecture/open communications platform had solved over a decade ago. The process we observe on the high-speed Internet is like strangulation through the exercise of market power. By cutting off access to advanced telecommunications service – the oxygen of the Internet market – facility-owners have eliminated competition at the level of applications and services. The threat of withholding functionality or banning applications chills innovation.

CONCLUSION

The track record of negotiated agreements for nondiscriminatory access to the advanced telecommunications network operated by the cable companies shows that voluntary opening of proprietary networks is highly unlikely. The recent report on Competition in the Multichannel Video market underscores just how dismal the prospects for voluntary negotiations are. The Commission notes that "some … Other cable operators offer consumers a choice among multiple ISPs." In fact, the use of the words "some" and "other" grossly overstate the extent of voluntarily negotiated carriage. The only voluntary carriage agreements the Commission cites apply to two cable systems operated by Comcast, one in Boston and the other in Seattle.[295] These have allowed six unaffiliated ISPs to have commercial access to their subscribers. Given the size of the industry, if private negotiations were working reasonably, we would expect to see hundreds, if not thousands of deals, not a handful, all of which were announced during a merger review. This must be considered an utter failure of private negotiations.

The recent failure of voluntary negotiations to solve the impasse in the Triennial Review Order and the effort by the dominant incumbent local exchange carriers (ILECs) to impose anticompetitive and discriminatory conditions on their interconnection agreements with competitive local exchange carriers (underscore the critical need for continued oversight over the terms and conditions of interconnection and carriage on the telecommunications network. The strong-arm tactics by the ILECs provide a very stark reminder that the public interest is not served when dominant firms in an interconnected network can dictate the success or failure of competitors and service providers by selectively offering favorable terms to unaffiliated entities who agree not to compete too vigorously with incumbents.

The potential harm that the abuse of ILEC market power poses in relation to interconnection for traditional voice grade service is compounded for advanced telecommunications services, where they would exercise control over innovation by controlling the functionality of the network to dictate which innovative services flourish and which wither and die. In the voice context, price is the primary concern; in the information service context, while price remains a concern, innovation is even more important.

The lesson that must be learned from the outrageous behavior of the ILEC, even when under close scrutiny, and the continuing failure of the cable operators to offer reasonable terms for access to their advanced telecommunications networks is that owners of last mile facilities will not voluntarily agree to interconnection agreements that are just and reasonable. With two wires dominating the last mile distribution and few alternatives available to most residential consumers, competition is inadequate to force the owners of distribution facilities to bargain fairly with alternative suppliers of voice and data services. They maximize their profits by leveraging their control over the last mile facilities and preventing unaffiliated service providers from competing over the last mile facilities.

By leveraging their facilities they gain a large, "first mover" advantage with the most attractive early adopting customers. The closure of the advanced telecommunications network to unaffiliated service providers and the obstacles that last mile facility owners have thrown in the path of competitors have had a devastating effect on competition and innovation in advanced services. The failure of the Federal Communications Commission to follow the law and require cable operators to provide nondiscriminatory access to their advanced telecommunications networks and the inadequate oversight over access to the advanced telecommunications services of the ILECs has destroyed the incentive for innovation in broadband services. The ranks of the ISPs and CLECs have been devastated and innovation has stalled in the broadband product space.

VI. THE LAYERED APPROACH TO DEFINING SERVICES UNDER THE TELECOMMUNICATIONS ACT OF 1996

This chapter applies the layered concept to another area of major policy concern in the digital communications platform, how to classify services that are supported by the Internet protocols, referred to as IP-enabled services.[296] It is truly ironic to read in the FCC's IP-enabled order that "in recent years, several observers have urged reliance on a 'layered' model to address VOIP and other areas of regulatory concern."[297] In fact, as is widely recognized outside of the Commission, by adopting a layered approach over three decades ago with the Computer Inquiries, the FCC created one of the key building blocks on which the Internet rests – nondiscriminatory access to interconnection and carriage on the telecommunications network.

The FCC has been in a quandary about how to treat services using the Internet Protocols and many other aspects of broadband Internet policy, primarily because of its consistent and persistent failure to implement the Telecommunications Act as written and intended by Congress. In a vain attempt to eliminate the public interest obligations of nondiscriminatory interconnection and carriage for the nation's advanced telecommunications networks, the Commission has distorted and disregarded the clear distinction Congress drew between telecommunications services and information services.[298] Thus the Commission does not need to break new ground or invent new categories to deal with IP-enabled services. It simply needs to recall its own success in the Computer Inquiries,[299] read the law carefully and implement it in a manner that is faithful to the intent of Congress, which was, itself, greatly influenced by the success of the regulations implemented by the Computer Inquiries.

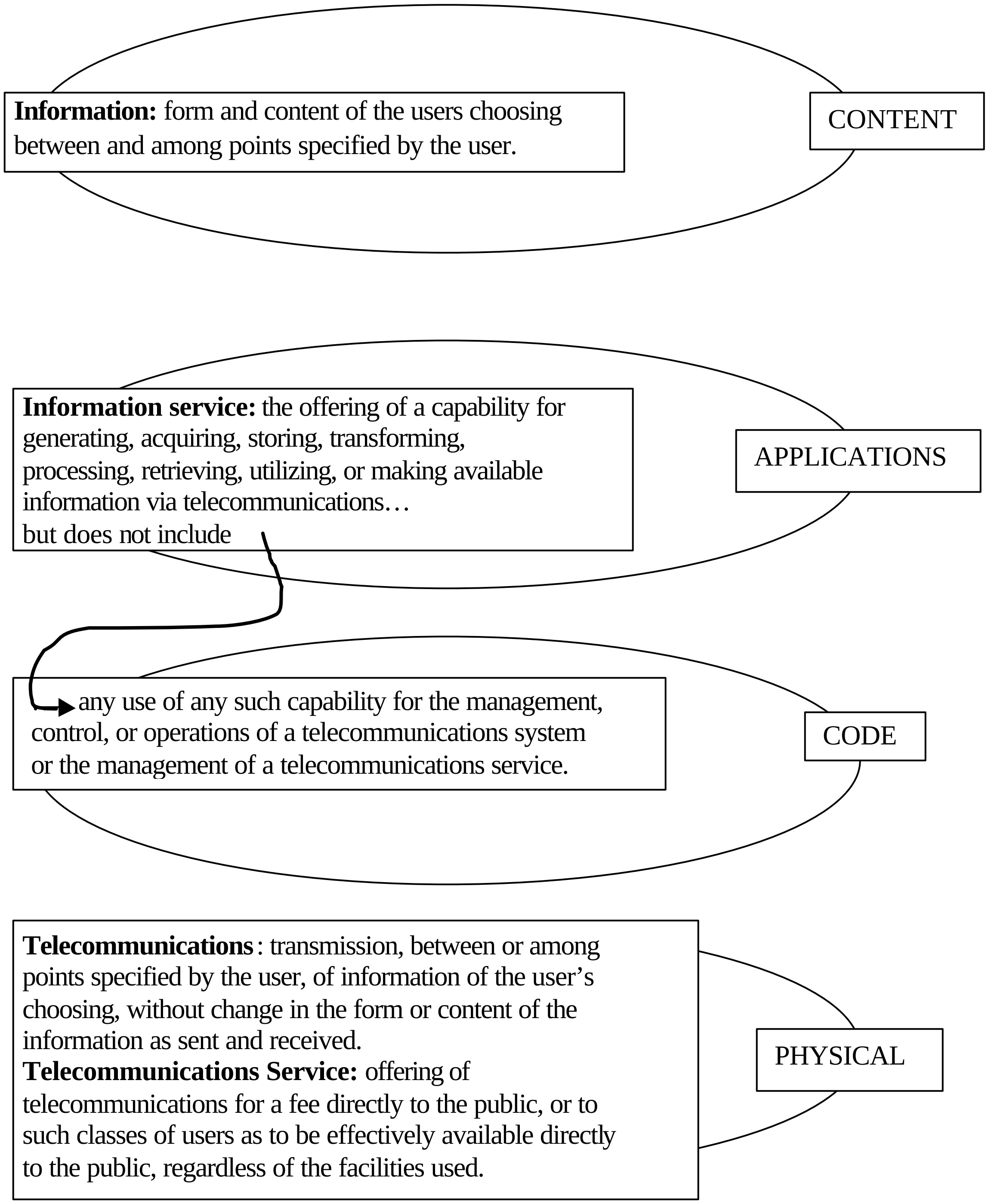
TELECOMMUNICATIONS AND INFORMATION SERVICES UNDER THE 1996 ACT

Legal Definitions

Exhibit VI-1 shows that the series of interrelated definitions in the 1996 Act fits the four-layered platform perfectly. This should not be surprising since the language of the 1996 Act adopted the definitional framework that the FCC had articulated over a period of two decades based on real world experience in the digital environment of the Computer Inquiries. Telecommunications services are subject to the full range of public interest obligations under the Communications Act. Information services are not.

> The term "telecommunications" means the transmission between or among points specified by the user, of information of the user's choosing, without change in the form or content of the information as sent and received.
>
> The term "telecommunications service" means the offering of telecommunications for a fee directly to the public, or to such classes of users as to be effectively available directly to the public, regardless of the facilities used.

Exhibit VI-1: Layers of the Digital Communications Platform Compared to the Definitions in the Telecommunications Act of 1996



> The term "information service" means the offering of a capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing, or making available information via telecommunications, and includes electronic publishing, but does not include any use of any such capability for the management, control, or operations of a telecommunications system or the management of a telecommunications service.[300]

Congress crafted this language carefully to ensure that consumers and service providers are protected from unjust rates and unreasonable discrimination and that the public interest is promoted in the deployment of telecommunications networks and services. Sections 201 and 202 of the Communications Act specify the core interconnection and carriage obligations:

> Sec. 201 (a) It shall be the duty of every common carrier… to furnish such communications service upon reasonable request therefore; and, in accordance with the orders of the Commission in cases where the Commission… finds such action necessary or desirable in the public interest, to establish physical connections with other carriers, to establish through routes and charges applicable thereto and the divisions of such charges, and to establish and provide facilities and regulation for operating such through routes.
>
> (b) All charges, practices, classifications, and regulations for and in connection with such communications service shall be just and reasonable…
>
> 202 (a) It shall be unlawful for any common carrier to make any unjust or unreasonable discrimination in charges, practices, classifications, regulations, facilities, or services for or in connection with like communication service, directly or indirectly, by any means or device, or to make or give any undue or unreasonable preference or advantage to any particular person, class of persons, or locality to any undue or unreasonable prejudice or advantage.

The definitions adopted by Congress make it clear that transmission over the telecommunications network on which IP-enabled services rely is a telecommunications service. The plain language of the statute has led the Ninth Circuit to that conclusion twice over the course of the past four years. The Court looked carefully at the combination of two services inherent in selling Internet access to the public for a fee and concluded that the underlying transmission functionality is a telecommunications service.

> Under the statute, Internet access for most users consists of two separate services. A conventional dial-up ISP provides its subscribers access to the Internet at a "point of presence" assigned a unique Internet address, to which the subscribers connect through telephone lines. The telephone service linking the user to the ISP is classic "telecommunications"…
>
> ISPs are themselves users of telecommunications when they lease lines to transport data on their own networks and beyond on the Internet backbone. However, in relation to their subscribers, who are the "public" in terms of

statutory definition of telecommunications service, they provide "information services," and therefore are not subject to regulation as telecommunications carriers.

Like other ISPs, [AT&T's cable broadband service] consists of two elements: a pipeline (cable broadband instead of telephone lines), and the Internet service transmitted through that pipeline. However, unlike other ISPs, [the cable broadband provider] controls all of the transmission facilities between its subscriber and the Internet. To the extent [a cable broadband provider] is a conventional ISP, its activities are one of an information service provider. However, to the extent that [a cable operator] provides its subscribers Internet transmission over its cable broadband facility, it is providing a telecommunications service as defined in the Communications Act.[301]

Characteristics Of Services That Indicate How They Should Be Categorized

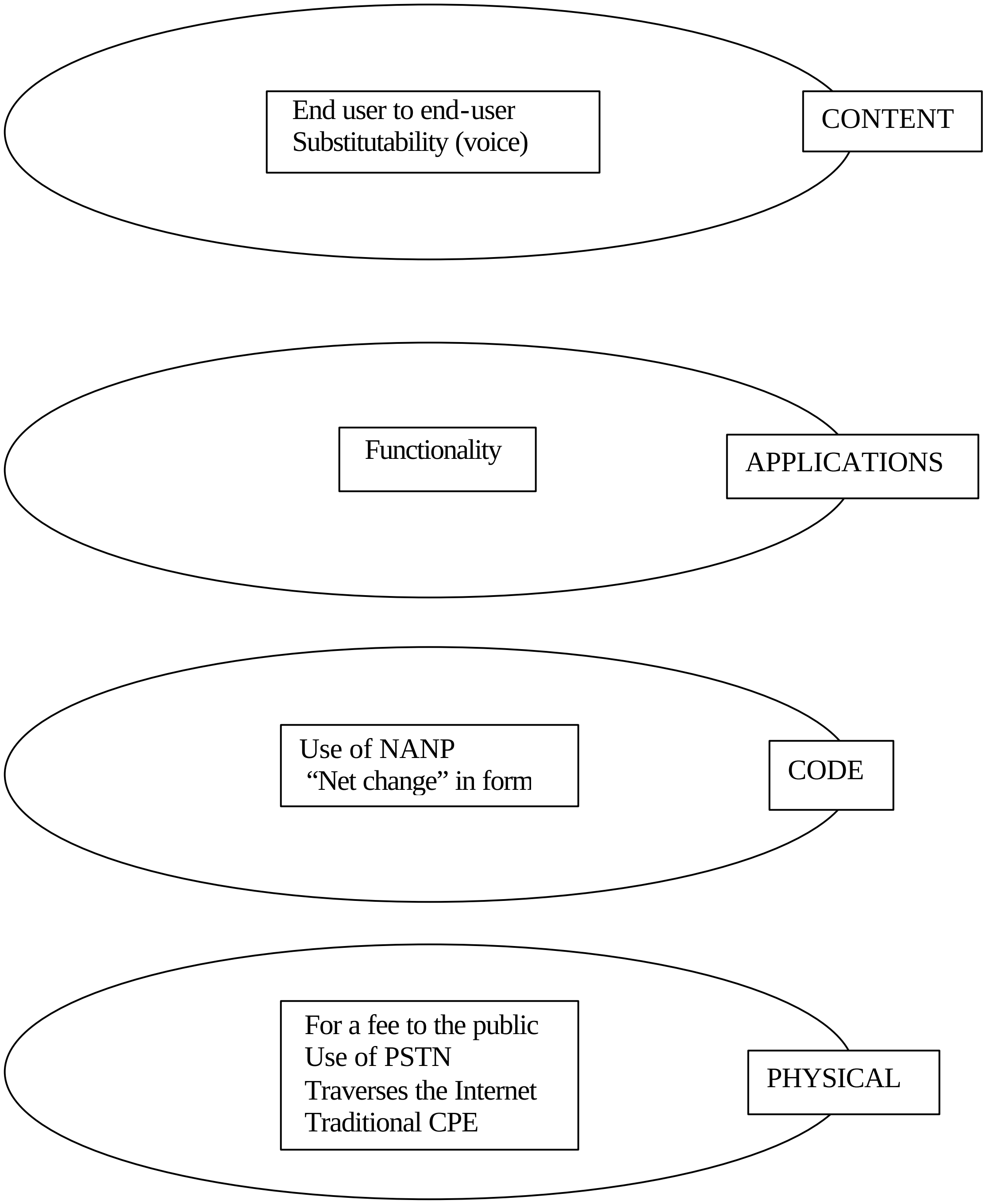
In the 1996 Act, Congress made it clear that not every transmission is a telecommunications service and not every application is an information service. The nature of a service is not defined by the technology or the protocols used to manage the network; it is defined by what the service does and how it is offered to the public. Congress rejected the idea that the use of a new technology or the use of a new switching protocol automatically renders a service an information service. In fact, it said quite the opposite.

The fact that the underlying transmission is a telecommunications service does not mean that the application riding on it cannot be a telecommunications service as well. Each of the components must be analyzed separately to determine how to define the service. The Ninth Circuit concluded that a service sold to the public could combine both a telecommunications service for transmission and an information service. It is obvious that a service sold to the public could also combine two telecommunications services.

Each party seeking to convince the Commission that it must define a service one way or the other invokes a single indicator that is claimed to be dispositive. In a converging network, however, such lines will be difficult to draw. In the past, the Commission has set out to find indicators of the nature of the service defined by the nature of the transmission, its management and function.[302] As described in Exhibit VI-2, the Commission has been easily able to find the means to preserve the definition (and therefore regulation) of voice service as a telecommunications service within the statute, precisely because the language of the statute allows for careful analysis of the functions and the layers of the platform.

Since IP-enabled services involve use of protocols most intensely, we might start at the code layer. Here Congress provided explicit direction that changes in protocols for the purposes of network or service management does not change the definition of the service. Thus, the initial attempt of the Commission to deal with these matters in the Stevens Report relied on the concept of a "net change" in the form of the transmitted message.[303] It used the distinction between the code layer and the applications layer to conclude that a change in the protocol to or the service does not create an information service. That a transmission begins

Exhibit VI-2: Indicia of Distinction between Telecommunications & Information Service Across Layers of the Digital Communications Platform



and ends as a voice call, but is managed by being divided into packets, does not make it an information service.

Analysis of the relationship to the North American Numbering Plan is also a code level consideration. Reliance on the existing telecommunications addressing protocol is an indicator that the service remains a telecommunications service and no change has taken place.

The Commission has examined criteria at the physical layer as well. The issue of whether a physical connection is offered to the public for fee has played a large role in the cable modem proceeding. The Commission has claimed that a "stand-alone" offer of the connection is what Congress meant when it used the words "for a fee" in the statute. The Ninth Circuit has rejected the FCC's interpretation of the 1996 Act.

Examination of the customer premise equipment (CPE) used is another undertaking. Little or no change in the CPE suggests little change in the service.

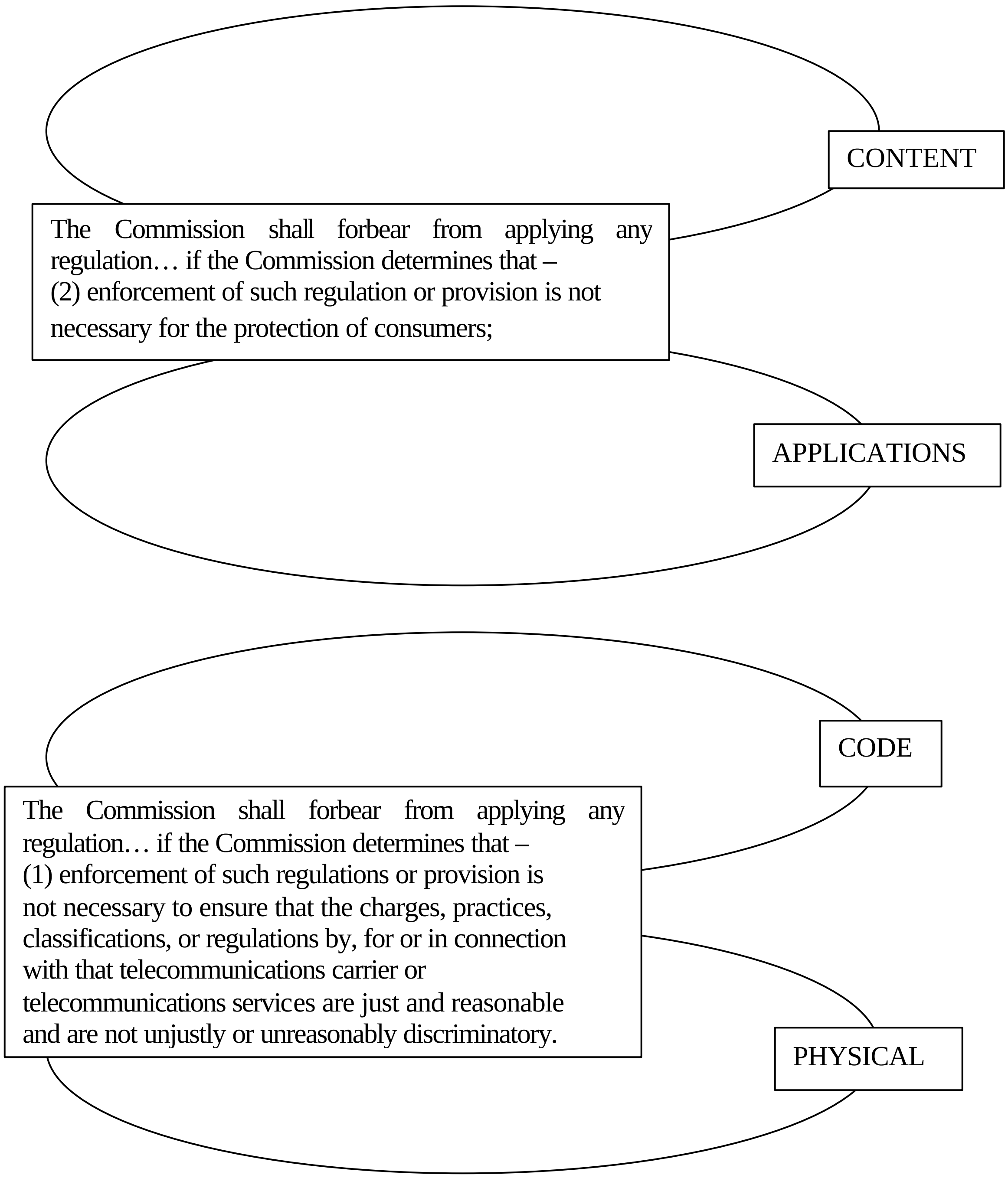
Similarly, reliance on the public switched network to originate or terminate calls is an area of inquiry. If a transmission never traverses the public switched network, the case that this is not a telecommunications service may be strengthened. The opposite is true as well. The question of whether the service actually traverses the Internet (as opposed to merely using Internet protocols) can also play a role. AT&T called its service an IP-like service in recognition that the transmission never actually traversed the Internet. It was entirely under its direct management and control on a proprietary backbone, when it was not on the public switched network.[304] This suggests it is just a new way of managing an existing telecommunications service.

At the applications layer, the question of functionality is central. The heart of the information service definition involves the functions or capabilities that are supplied. Delivery of voice calls in real time is a distinct function. Similarly, in the 911 proceeding, the functionality of providing real-time, two-way communications was a consideration.

At the content layer, the critical issue is the way the end-user interacts with the data. Does the end-user control the content and direction of the transmission? Is there an end-user to end-user connection? How are services marketed to and perceived by consumers (e.g., is the service marketed and does the end-user perceive the service as a substitute for a telecommunications service)? In the 911 proceeding, consumer expectations played a key role.

These are all interesting questions that apply to various policies that affect different layers of the platform. The answers will vary depending on the specific services being analyzed. The distinctions are frequently lost under the broad banner of deregulation. Exhibit VI-3 shows how the Commission has disposed of these issues in the two recent orders dealing with IP-enabled services. It adds in the characteristics of Vonage-type services.

Exhibit VI-3: Forbearance Determinations in Relation to the Layers of the Digital Communications Platform



By this definitional approach, the Commission got the answers right. AT&T's service is clearly a telecommunications service; for Pulver the preponderance of the evidence points in the opposite direction.[305] All of the critical physical layer and code layer indicia point to AT&T's offering as a telecommunication service, while they do the opposite for Pulver. The effort by VOIP service providers to define all IP-enabled services as information services must be rejected.[306] Vonage-type services appear to be much more like AT&T's offering, which was categorized as a telecommunications service, than the Pulver offering, which was categorized as an information service.

The criteria on which a blanket definition rests contradict the intent of the statute. The use of Internet protocols to manage a service that originates and terminates as a voice call and the use of different facilities to transmit those calls do not negate the fact that it is a telecommunications service. The fact that information services might be offered alongside or in combination with telecommunications services does not negate the fact that a telecommunications service is being offered to the public for a fee. Offering voice mail service (an information service that stores voice messages using a telecommunications service) does not change the classification of the underlying service. A service that allows voice mail to be transformed to e-mail does not change the categorization of the underlying service. The separate voice mail/e-mail conversion service would be an information service.

The fact that these service providers own no facilities is not dispositive as a matter of law and only underscores the public policy concerns.[307] One of the fundamental issues in this proceeding is the care and maintenance of the nation's telecommunications infrastructure. Declaring oneself a free rider on that infrastructure does not solve the problem, it highlights it.

REMOVING REGULATION UNDER THE 1996 ACT

Legal Criteria

Having defined an IP-enabled service as a telecommunications service, the Commission does not have to impose regulation. It can forbear from federal regulation.[308] To the extent that the Commission would like to forbear from imposing public interest obligations on specific telecommunications services in specific geographic areas, it must engage in a full and complete proceeding under Section 10 of the 1996 Act. To date it has not. In order to forbear the Commission must make a series of findings.

> The Commission shall forbear from applying any regulation or any provision of this Act to a telecommunications carrier or telecommunications service, or class of telecommunications carriers or telecommunications services, in any or some of its or their geographic markets, if the Commission determines that –
>
> (1) enforcement of such regulation or provision is not necessary to ensure that the charges, practices, classifications, or regulations by, for, or in connection with that telecommunications carrier or telecommunications service are just and reasonable and are not unjustly or unreasonably discriminatory;

> (2) enforcement of such regulation or provision is not necessary for the protection of consumers; and
>
> (3) forbearance from applying such provision or regulation is consistent with the public interest.[309]

It is noteworthy that the first prong of the forbearance test uses terms from the common carrier language of sections 201 and 202 of the Communications Act that seem to target the physical and code layers of the platform (see Exhibit VI-4). The second prong deals with consumer protection, which has typically involved behavior at the higher layers of the platform – e.g., whether or not service works as claimed, whether information provided to the public is adequate and accurate, etc.

Exhibit VI-5 identifies the various public policy issues and how they should be handled at the federal and state levels for IP-enabled services of the Vonage type.

Forbearance at the Physical and Code Layers

The Commission cannot forbear regulating VOIP services offered by owners of advanced telecommunications networks. The advanced telecommunications services provided by telecommunications carriers fail all three prongs of the forbearance test. Unregulated telecommunications service providers will charge rates and impose conditions that are unjust and unreasonably discriminatory. Consumers will be abused and the public interest will not be served.

The case against forbearance at the physical layer can easily be made based on the feebleness and unevenness of competition in telecommunications facilities. The demonstrated willingness of network owners to foreclose their networks or discriminate against unaffiliated service providers and their imposition of restrictions on consumer use of the advanced telecommunications networks makes the case for continuing the public interest obligations. As demonstrated in the previous two sections, there is every reason to believe that regulation is necessary to prevent unjust and unreasonably discriminatory rates, terms and conditions and to protect consumers. The balance that Congress struck between the private interest of network owners and the public interest obligations, under which they are required to operate by the Communications Act of 1934 and the Telecommunications Act of 1996, has not been "upset" by the growth of competition. On the contrary, the vibrant competition and innovation on the Internet that Congress sought to preserve was made possible by the obligation to provide nondiscriminatory interconnection and carriage. That competition is severely threatened by the failure of the Commission to ensure nondiscriminatory treatment of service providers and consumers for the advance telecommunications networks on which the Internet increasingly depends.

An even stronger case can be made that the third prong of the test – public interest – provides an independent basis for regulation of telecommunications services. The Commission must recognize the immense positive externalities of a ubiquitous, open, telecommunications network. The network effects at the core of a digital information economy vastly exceed the sum of the private interests of the owners of telecommunications

Exhibit VI-4: Indicia of the Type of Service: AT&T v. Pulver

Telecommunication Service						**Information Service**

Technical & Economic Traits

CONTENT LAYER

AT&T	◄	Yes	End user to end user	No	►	Pulver (a)[1]
AT&T, Pulver (limited)[2]	◄	Yes	Substitutability (voice)	No		

APPLICATIONS LAYER

AT&T, Pulver	◄	Yes	Functionality	No		
AT&T, Pulver	◄	Yes	Real-time, 2-Way	No		

CODE LAYER

AT&T	◄	Yes	Use of NANP	No	►	Pulver
AT&T	◄	No	"Net change" in form	Yes	►	Pulver (a)

Physical Layer

AT&T	◄	Yes	For a fee to the public	No	►	Pulver
AT&T	◄	Yes	Use of PSTN	No	►	Pulver
AT&T	◄	No	Traverses the Internet	Yes	►	Pulver
AT&T	◄	Yes	Traditional CPE	No	►	Pulver
AT&T	◄	Yes	(Back Power)	No	►	Pulver

[1] Pulver is defined as a directory service in which end-users communicated with the Internet Service Provider, not another end-user. End-user to end-user communications is established in a separate transmission that relies on a peer-to-peer relationship.
[2] Service is limited to peers only and is not available for the general public.

Exhibit 6: Indicia of the Type of Service: Vonage
(Arrows in both directions indicate uncertainty mixed results)

<u>Telecommunication Service</u>					**<u>Information Service</u>**

<u>Technical & Economic Traits</u>

CONTENT LAYER

Vonage	◄	Yes	End user to end-user	No	
Vonage	◄	Yes	Substitutability (voice)	No	

APPLICATIONS LAYER

Vonage	◄	Yes	Functionality	No	
Vonage	◄	Yes	Real-time, 2-Way	No	

CODE LAYER

Vonage	◄	Yes	Use of NANP	No	
Vonage	◄	No	"Net change" in form	Yes ►	Vonage[3]

<u>Physical Layer</u>

Vonage	◄	Yes	For a fee to the public	No	
Vonage	◄	Yes	Use of PSTN	No	
		No	Traverses the Internet	Yes ►	Vonage
Vonage	◄	Yes	Traditional CPE	No ►	Vonage[4]
	◄	Yes	(Back Power)	No ►	Vonage (c)[5]

[3] This analysis turns on where one assumes the initial form of the transmission is established.
[4] The CPE contains equipment in addition to a traditional handset.
[5] The question of back-up power may depend on the configuration of high speed Internet service.

facilities. It is such network effects that the owners of telecommunications facilities are least able to see, but the Commission foresaw in the Computer Inquiries. The mere threat or possibility of discrimination, not to mention the demonstrated pattern of anticompetitive and anti-consumer behavior by physical layer telecommunications service providers, poisons the environment for innovation.

Non-facilities based IP-enabled service providers lack market power at the physical layer and therefore the ability to discriminate. They are unlikely to be able to discriminate at the code layer as well. However, the Commission should not forbear from regulating to the extent that telecommunications service providers should not be allowed to withhold functionality or impair competing services by refusing to interoperate with other service providers. With that caveat, non-facilities based VOIP providers would meet the first prong of the forbearance test.

Because a service provider lacks market power in the physical layer does not mean that they should be allowed to ride for free on the telecommunications infrastructure. Service that uses the infrastructure should be required to help cover its costs. All service providers should pay for the use of the network in an equitable manner, but cost recovery mechanisms can be complex.

What is unclear at present is whether and the extent to which VOIP service providers of the Vonage type pay today. Reliance on the public switched network in the case of Vonage-type services results in payment to established interexchange carriers (IXCs) and CLECs. To the extent fees are collected on a per minute or revenue basis, the VOIP provider may already be paying. To the extent that contribution for public policy programs is collected on a per line basis, VOIP providers may not be contributing and they should. These questions merit further proceedings at the federal and state levels. Moreover, at the federal level there are ongoing proceedings to reform compensation mechanisms. Collection of revenues from VOIP providers should be rolled into those proceedings and not begin until they are concluded. As was the case with cellular service, the nontraditional provisioning of VOIP does present new challenges to assessing intercarrier compensation and universal service fees. To the extent that there are technology differences that make it difficult to calculate precisely the equitable payments, the FCC should use a safe harbor, as it did with cellular carriers.

FORBEARANCE AT THE APPLICATIONS AND CONTENT LAYERS

Whether IP-enabled telecommunications services meet the second and third prongs of the forbearance test (independent of the physical and code layers) is a matter for analysis. The need for consumer protection regulation arises from the nature of the service provided and the state of the marketplace that provides it. Necessities tend to receive greater regulatory attention. Sustained and vigorous competition provides the best consumer protection and is the only basis for forbearance. Presently, both the FCC and the state public utility commissions provide consumer protection through minimal regulation of various aspects of the transaction.

Federal authorities require truth in billing and prohibit slamming. Congress required regulation of the use of customer proprietary network information to protect privacy. State authorities regulate the quality of service and seek to ensure that companies meet minimum financial and managerial standards.

The persistence of these regulations reflects the nascent nature of competitive sale of local telephone service and continuing problems in these new markets. The thousands of complaints and problems that led to the adoption and continuation of these regulations undermine the claim that the market will take care of such abuses. Consumer protection regulation reflects market conditions, not the characteristics of individual companies. The FCC and state commissions have not suggested that the market is mature enough to allow the removal of consumer protection regulation for other suppliers of services for which Vonage-type services are offered to the public as a substitute. Selective exemption from regulation for a service that is a direct substitute for regulated services creates an unlevel playing field and triggers a race to the bottom. The Commission cannot forbear providing consumer protection through regulation by simply assuming or hoping that VOIP will magically transform the telecommunications marketplace into a competitive, consumer friendly environment. It should not exempt one service until it is prepared to declare that all similar services no longer need to be regulated.

There are certain public goods that regulators might well find will not be provided, no matter how competitive the marketplace becomes. E-911 service is such a public good. Allowing optional participation creates a free rider problem that can ultimately undermine the entire service. It robs the public of the protection of a ubiquitous E-911 service. We doubt that the Commission can find that forbearing from E-911 regulation is in the public interest.

Access for consumer with disabilities may be a similar public good. Telecommunications service providers may not find it profitable to serve such customers, no matter how competitive the market becomes, yet society demands that they be provided services that are "readily achievable."

To the extent that there are technical barriers to providing these services, service providers should be given a reasonable period of time to comply. Officials and private parties responsible for overseeing and implementing these policies should be required to work with IP-enabled service providers to meet their obligations.

Thus there is a good reason that Congress demanded a careful and detailed analysis of the status of telecommunications services before the Commission forbears from regulation. They are vital services that affect society in many important ways.

CONCLUSION

In part, the Commission gets away with its simple-minded and single-minded miscategorization of the transmission service offered to the public on the advanced telecommunications networks because there is no baseline against which to compare the effects of that error. Consumers are overcharged and denied choice, but they do not feel the abuse as intensely because they have never had these services in a competitive, consumer friendly environment. (They do not know what they are missing.) The Commission does not have such a luxury in voice services and has been forced to be much more refined in its treatment of the dial-up telecommunications network. Here misdefinition would make the anticompetitive and anti-consumer effects immediately apparent. If the Commission corrects its mistake at the physical and code layers to ensure nondiscrimination, it will have a much easier job of selling deregulation at the other layers.

Even if the Commission gets the physical and code layers right, the consumer protections and social regulation of services sold to the public remains a relevant area of public policy concern. Competition on the Internet may be the consumer's best friend, but it will be uneven and it will not solve all telecommunications related social problems. Where vital services and important social goals are at issue, public policy analysis is necessary. The issues should be separated and properly defined. The layered approach provides a useful analytic framework, particularly by helping policymakers to match solutions to the layers in which the problems arise.

VII. CONCLUSION

Communication platforms hold a special role in the "new" economy. This paper argues that the digital communications platform should be kept open. Specifically, the physical layer of facilities (the infrastructure of communications) must remain accessible to consumers and citizens, for it is the most fundamental layer in which to ensure equitable access to the rest of the communications platform. An open communications platform promotes a dynamic space for economic innovation and a robust forum for democratic discourse.

Arguments against open architecture ignore the history and incentives of owners of the physical facilities and they misunderstand the value and role of the digital communications platform. It has the unique characteristic of being both a bearer service that affects the ability of many industries to function, as all transportation and communications technologies do, and a general purpose, cumulative, systemic, enabling technology that alters the fundamental way in which numerous industries conduct their business and create technological progress. It is electricity, the railroads and the telephone rolled into one.

Closure of the information platform at a key choke point alters the nature of the environment. Discrimination in access diminishes the value of the network. The positive externalities of connectivity are reduced. The claim that we should focus on the physical infrastructure because that is where the value creation lies should be rejected. The true value in the network arises from the creative exploitation of functionalities at the higher levels of the platform, which is exactly what the monopolist or oligopolist cannot see. Even oligopolistic competition for a critical infrastructure industry will leave far too much rent and control in the hands of the network owners.

The lesson of the long history of layering of communications facilities, all subject to an obligation to provide nondiscriminatory access, converges with the lesson of network theory. The layering of open communications networks is an evolving process that has carried multiscale connectivity to ever higher levels. The greater the multiscale connectivity, the more conducive the network is for commerce, communication and innovation.

What is clear, then, is that maintaining an open communications platform for advanced services is the public policy that will ensure a vibrant, high-speed, next generation of the Internet. That policy choice is what will drive innovation, provide a greater flow of information and have a positive impact on the economy and society. The role of regulation should be to ensure that strategically placed actors (perhaps by historical favor) cannot deter expression or innovation at any layer of the platform. This is best achieved by mandating that the core infrastructure of the communications platform remain open and accessible to all.

ENDNOTES

[1] Mark Cooper, EXPANDING THE INFORMATION AGE FOR THE 1990S: A PRAGMATIC CONSUMER VIEW (January 11, 1990). This was the first in a series of reports that analyzed the effects of decentralized, open networks, prior to the dramatic commercial success of the Internet (*see* Mark Cooper, DEVELOPING THE INFORMATION AGE IN THE 1990S: A PRAGMATIC CONSUMER VIEW [June 8, 1992], "Delivering the Information Age Now, Telecom Infrastructure: 1993," TELECOMMUNICATIONS REPORTS, 1993, THE MEANING OF THE WORD INFRASTRUCTURE [June 30, 1994]).

[2] Cooper, EXPANDING THE INFORMATION AGE, *supra* note 1, at ES-1.

[3] Id., at ES-6.

[4] Id., at ES-5.

[5] Mark Cooper, THE IMPORTANCE OF ISPS IN THE GROWTH OF THE COMMERCIAL INTERNET: WHY RELIANCE ON FACILITY-BASED COMPETITION WILL NOT PRESERVE VIBRANT COMPETITION AND DYNAMIC INNOVATION IN THE HIGH-SPEED INTERNET (July 1, 2002); "Open Communications Platforms: The Physical Infrastructure as the Bedrock of Innovation and Democratic Discourse in the Internet Age," 2 J. ON TELECOMM. & HIGH TECH. L., 1 (2003).

[6] Id., at 12.

[7] Earl W. Comstock & John Butler, *Access Denied: The FCC's Failure to Implement Open Access as Required by the Communications Act*, J. OF COMM. L. & POL. (Winter 2000).

[8] Lawrence Lessig, THE FUTURE OF IDEAS (2001), at 148, emphasizes the break with the Computer Inquiries in the approach to advanced telecommunications services.

[9] Mark A. Lemley & Lawrence Lessig, *The End of End-to-End: Preserving the Architecture of the Internet in the Broadband Era*, 48 UCLA L. REV. 925, 935 (2001) (written as a direct response to James P. Speta, *Written Ex Parte*, APPLICATION FOR CONSENT TO THE TRANSFER OF CONTROL OF LICENSES OF MEDIAONE GROUP, INC. TO AT&T CORP. FCC DOC. NO. 99-251 (1999)). *See also* James B. Speta, *The Vertical Dimension of Cable Open Access*, 71 U. COLO. L. REV. 975 (2000); Phil Weiser, *Paradigm Changes in Telecommunications Regulation*, 71 U. COLO. L. REV. 819 (2000) (responding to an earlier piece by Lemley & Lessig, *Written Ex Parte*, APPLICATION FOR CONSENT TO TRANSFER CONTROL OF LICENSES OF MEDIAONE GROUP INC. TO AT&T CORP., FCC DOC. NO. 99-251 (1999) *available at* http://cyber.law.harvard.edu/works/lessig/filing/lem-les.doc.html.

[10] Janet Abbate, INVENTING THE INTERNET (1999).

[11] Id.; Lawrence Lessig, CODE AND OTHER LAWS OF CYBERSPACE (1999).

[12] David B. Audretsch & Paul J.J. Welfens (eds.) THE NEW ECONOMY AND ECONOMIC GROWTH IN EUROPE AND THE US (2002), at 18.

[13] Identical language is used to describe advanced telecommunications services over cable networks and telephone company advanced telecommunications networks; *see* Federal Communications Commission, *Notice of Proposed Rulemaking*, IN THE MATTER OF APPROPRIATE FRAMEWORK FOR BROADBAND ACCESS TO THE INTERNET OVER WIRELINE FACILITIES, UNIVERSAL SERVICE OBLIGATIONS OF BROADBAND PROVIDERS, COMPUTER III FURTHER REMAND PROCEEDING: BELL OPERATING COMPANY PROVISION OF ENHANCED SERVICES; 1998 BIENNIAL REGULATORY REVIEW – REVIEW OF COMPUTER III AND ONA SAFEGUARDS AND REQUIREMENTS, CC Docket No. 02-33; CC Docket Nos. 95-20, 98-10, para. 25, and Federal Communications Commission, *Declaratory Ruling and Notice of Proposed Rulemaking*, IN THE MATTER OF INQUIRY CONCERNING HIGH-SPEED ACCESS TO THE INTERNET OVER CABLE AND OTHER FACILITIES, INTERNET OVER CABLE DECLARATORY RULING, APPROPRIATE REGULATORY TREATMENT FOR BROADBAND ACCESS TO THE INTERNET OVER CABLE FACILITIES, GN Docket No. 00-185, CS Docket No. 02-52, March 15, 2002, para. 41. The cable operators were officially excused from the obligation for nondiscrimination by the declaratory ruling. The FCC excused telephone companies from many of their obligations in a third order (*see Report and Order on Remand and Further Notice of Proposed Rulemaking*, IN THE MATTER OF REVIEW OF SECTION 251 UNBUNDLING OBLIGATIONS OF INCUMBENT LOCAL EXCHANGE CARRIERS, IMPLEMENTATION OF THE LOCAL COMPETITION PROVISIONS OF THE TELECOMMUNICATIONS ACT OF 1996, DEPLOYMENT OF WIRELINE SERVICE OFFERING ADVANCED TELECOMMUNICATIONS CAPABILITY, CC Docket Nos. 01-338, 96-98, 98-147).

[14] Mark Cooper, TRANSFORMING THE INFORMATION SUPER HIGHWAY INTO A PRIVATE TOLL ROAD (October, 1999), at 3. *See* also, *Reply Comments of Center for Media Education, et al.*, INQUIRY CONCERNING THE

DEPLOYMENT OF ADVANCED TELECOMMUNICATIONS CAPABILITY TO ALL AMERICANS IN A REASONABLE AND TIMELY FASHION, AND POSSIBLE STEPS TO ACCELERATE SUCH DEPLOYMENT PURSUANT TO SECTION 706 OF THE TELECOMMUNICATIONS ACT OF 1996, Federal Communications Commission, CC Docket No. 98-146, October 10, 1998; *Petition to Deny Consumers Union, et al*., JOINT APPLICATION OF AT&T CORPORATION AND TELE-COMMUNICATIONS INC. FOR APPROVAL OF TRANSFER OF CONTROL OF COMMISSION LICENSES AND AUTHORIZATIONS, FEDERAL COMMUNICATIONS COMMISSION, CS Docket No. 98-178, October 28, 1998.

[15] *Comments of Texas Office of Public Utility Counsel, Consumer Federation of America, Consumers Union,* IN THE MATTER OF INQUIRY CONCERNING HIGH SPEED ACCESS TO THE INTERNET OVER CABLE AND OTHER FACILITIES, Federal Communications Commission, GN Docket No. 96-262, December 12, 1999, January 12, 2000; *Comments of Consumers Union, et al.*, INQUIRY CONCERNING HIGH-SPEED ACCESS TO THE INTERNET OVER CABLE AND OTHER FACILITIES, GEN Docket No. 00-185 (filed December 1, 2001); *Comments of Texas Office of Consumer Counsel, Consumer Federation of America,* IN THE MATTER OF INQUIRY CONCERNING HIGH-SPEED ACCESS TO THE INTERNET OVER CABLE AND OTHER FACILITIES; DECLARATORY RULING; APPROPRIATE REGULATORY TREATMENT FOR BROADBAND ACCESS TO THE INTERNET OVER CABLE FACILITIES, Federal Communications Commission**,** GN Dockets Nos. 00-185, CS Dockets No. 02-52, March 15, 2002. Having failed to implement any obligations for nondiscrimination as part of a Further Notice of Proposed Rulemaking, Chairman Powell (*Preserving Internet Freedom: Guiding Principles for the Industry,* the DIGITAL BROADBAND MIGRATION: TOWARD A REGULATORY REGIME FOR THE INTERNET AGE, UNIVERSITY OF COLORADO SCHOOL OF LAW, February 8, 2004) declared four Internet freedoms that he believes must be preserved, but he was unwilling to make them mandatory.

[16] *Comments of Arizona Consumer Council, et al*., IN THE MATTER OF APPROPRIATE FRAMEWORK FOR BROADBAND ACCESS TO THE INTERNET OVER WIRELINE FACILITIES UNIVERSAL SERVICE OBLIGATIONS OF BROADBAND PROVIDERS COMPUTER III FURTHER REMAND PROCEEDINGS: BELL OPERATING COMPANY PROVISION OF ENHANCED SERVICES; 1998 BIENNIAL REGULATORY REVIEW – REVIEW OF COMPUTER III AND ONA SAFEGUARDS AND REQUIREMENTS, Federal Communications Commission, CC Dockets Nos. 95-20, 98-10, May 3, 2002; Reply Comments, July 1, 2002; *Comments and Reply Comments of The Consumer Federation of America, Texas Office of Public Utility Counsel, Consumers Union, and Center For Digital Democracy*, IN THE MATTER OF REVIEW OF THE SECTION 251 UNBUNDLING, OBLIGATIONS OF INCUMBENT LOCAL EXCHANGE CARRIERS, IMPLEMENTATION OF THE LOCAL COMPETITION PROVISIONS OF THE TELECOMMUNICATIONS ACT OF 1996, DEPLOYMENT OF WIRELINE SERVICES OFFERING ADVANCED TELECOMMUNICATIONS CAPABILITY, Federal Communications Commission, CC Dockets Nos. 01-338, 96-98, 98-147, April 5, 2002.

[17] *Brand X Internet Services v FCC*, Ninth Circ. No. 02-70518, October 6, 2003.

[18] Lessig, FUTURE, *supra* note 8, at 23, notes that Tim Berners-Lee, WEAVING THE WEB: THE ORIGINAL DESIGN AND ULTIMATE DESTINY OF THE WORLD WIDE WEB BY ITS INVENTOR (1999), at 129-30, identified four layers: transmission, computer, software and content.

[19] Carl Shapiro & Hal Varian, INFORMATION RULES: A STRATEGIC GUIDE TO THE NETWORK ECONOMY (1999), at 9-15; Richard N. Langlois, *Technology Standards, Innovation, and Essential Facilities: Toward a Schumpeterian Post-Chicago Approach*, in DYNAMIC COMPETITION & PUBLIC POLICY: TECHNOLOGY, INNOVATIONS, AND ANTITRUST ISSUES (Jerry Ellig, ed., 2001), at 193, 207 *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=204069 (last visited Jan. 24, 2003).

[20] Shane Greenstein, *The Evolving Structure of the Internet Market*, in UNDERSTANDING THE DIGITAL ECONOMY (Erik Brynjolfsson & Brian Kahin, eds., 2000), at 155.

[21] Id., at 155.

[22] Sara Baase, A GIFT OF FIRE: SOCIAL, LEGAL AND ETHICAL ISSUES IN COMPUTING (1997); George Gilder, TELECOMS: HOW INFINITE BANDWIDTH WILL REVOLUTIONIZE OUR WORLD (2000).

[23] Brian R. Gaines, *The Learning Curve Underlying Convergence*, TECHNOLOGICAL FORECASTING & SOC. CHANGE (Jan./Feb. 1998), at 30-31.

[24] Bruce Owen, THE INTERNET CHALLENGE TO TELEVISION (1999), at 29.

[25] Id., at 151.

[26] Shapiro & Varian, INFORMATION RULES, *supra* note 19, at 22-23.

[27] High first copy costs are an enduring quality of information that is reinforced in the industrial age by the presence of high capital costs. In the pre-industrial and (perhaps) post-industrial periods first copy costs entail high human capital costs.

[28] Gaines, *The Learning Curve, supra* note 23, at 30-31.

[29] C. Edwin Baker, MEDIA, MARKET AND DEMOCRACY (2001), at 8.

[30] Shapiro & Varian, INFORMATION RULES, *supra* note 19, at 22-23.

[31] Yochai Benkler, *Intellectual Property and the Organization of Information Production*, 22 INT'L REV. L. & ECON. 81 (2002), *available at* http://www.law.nyu.edu/benklery/IP&Organization.pdf, (last visited Jan. 24, 2003) at 5; *see* also Baker, MEDIA MARKET, *supra* note 29, at 8-14.

[32] John B. Taylor, ECONOMICS (1998), at 412-25.

[33] Shapiro & Varian, INFORMATION RULES, *supra* note 19, at 13-17.

[34] W. Brian Arthur, *Positive Feedbacks in the Economy*, 262 SCIENTIFIC AM., 95 (Feb. 1990); *see* also W. Brian Arthur, *Competing Technologies, Increasing Returns and Lock-in by Historical Events*, 99 ECON. J. (1989).

[35] Distinctions between classes of users might be made, but all members of the class had the same access to the element.

[36] Gaines, *The Learning Curve, supra* note 23, at 20. *See*, e.g., James Gleick, FASTER: THE ACCELERATION OF JUST ABOUT EVERYTHING (1999); Jeffrey L. Sampler, *Redefining Industry Structure for the Information Age*, ENGINEERING MGMT. REV., 68 (Summer 1999).

[37] Stephen Moore & Julian L. Simon, *The Greatest Century That Ever Was: 25 Miraculous U.S. Trends of the Past 100 Years* (Cato Inst. Policy Analysis No. 364, 1999), at 24, *available at* http://www.cato.org/pubs/pas/pa364.pdf (last visited Jan. 24, 2003).

[38] Following Lessig's paradigm of modalities of regulation as interpreted as realms of social order in Mark Cooper, *Inequality in Digital Society: Why the Digital Divide Deserves All the Attention it Gets*, 20 CARDOZO ARTS & ENTERTAINMENT L. J., 93 (2002). We can track the technological transformation affecting the economy (see BRIE-IGCC E-conomy Project, TRACKING A TRANSFORMATION: E-COMMERCE AND THE TERMS OF COMPETITION IN INDUSTRIES (2001)), the polity (*see* GOVERNANCE.COM: DEMOCRACY IN THE INFORMATION AGE (Elaine Ciulla Kamarck & Joseph S. Nye Jr., eds., 2002)) and civic institutions (*see* Jeremy Rifkin, THE AGE OF ACCESS: THE NEW CULTURE OF HYPERCAPITALISM, WHERE ALL OF LIFE IS A PAID-FOR EXPERIENCE (2000), chs. 11-12; Andrew L. Shapiro, THE CONTROL REVOLUTION: HOW THE INTERNET IS PUTTING INDIVIDUALS IN CHARGE AND CHANGING THE WORLD WE KNOW (1999), chs. 20-21).

[39] Ida Harper Simpson, *Historical Patterns of Workplace Organization: From Mechanical to Electronic Control and Beyond*, CURRENT SOC. 47 (Apr. 1999); Barry Bluestone & Bennett Harrison, GROWING PROSPERITY: THE BATTLE FOR GROWTH WITH EQUITY IN THE TWENTY-FIRST CENTURY (2001), seeking historical parallels to previous technological revolutions, ultimately acknowledge uniqueness of current transformation; George Evans, et al., *Growth Cycles*, 88 AM. ECON. REV. 495 (1998).

[40] Erik Brynjolfsson & Brian Kahin, *Introduction*, in UNDERSTANDING THE DIGITAL ECONOMY (Erik Brynjolfsson & Brian Kahin, eds., 2000), at 1.

[41] Langlois, *Technology Standards, supra* note 19, at 207.

[42] François Bar, et al., *Defending the Internet Revolution in the Broadband Era: When Doing Nothing is Doing Harm* (1999), *at* http://e-conomy.berkeley.edu/publications/ wp/ewp12.pdf.

[43] *See* Yochai Benkler, *Coase's Penguin, or Linux and the Nature of the Firm* (paper presented at the CONFERENCE ON THE PUBLIC DOMAIN, DUKE UNIVERSITY LAW SCHOOL, Nov. 9-11, 2001), *at* http://www.law.duke.edu/pd/papers/ Coase's_Penguin.pdf (last visited Jan. 24, 2003), at 2.

[44] Manuel Castells, THE INTERNET GALAXY – REFLECTIONS ON THE INTERNET, BUSINESS, AND SOCIETY (2001), at 28.

[45] Yochai Benkler, *Property Commons and the First Amendment: Toward a Core Common Infrastructure*, BRENNAN CENTER FOR JUSTICE, NEW YORK UNIVERSITY LAW SCHOOL, March 2000.

[46] Langlois, *Technology Standards, supra* note 19.

[47] Benkler, *Coase's Penguin*, *supra* note 43, at 22-23.

[48] Cooper, *Inequality*, *supra* note 38.

[49] Marina N. Whitman, NEW WORLD, NEW RULES (1999), at 17, 32-37, 55-62.

[50] Manuel Castells, THE RISE OF NETWORK SOCIETY (1996); Richard C. Longworth, GLOBAL SQUEEZE (1998).

[51] Philip Evans & Thomas S. Wurster, BLOWN TO BITS: HOW THE NEW ECONOMICS OF INFORMATION TRANSFORMS STRATEGY (2000), at 17 (footnote omitted).

[52] National Research Council, REALIZING THE INFORMATION FUTURE (1994), at 43.

[53] Id., at 43.

[54] Id., at 44.

[55] *Comments of the High Tech Broadband Coalition*, IN THE MATTER OF APPROPRIATE REGULATORY TREATMENT FOR BROADBAND ACCESS TO THE INTERNET OVER CABLE FACILITIES, CC Docket No. 96-45, June 17, 2002, at 7-9 (hereafter Cable Modem Proceeding); *see* also *Reply Comments of the High Tech Broadband Coalition*, IN THE MATTER OF APPROPRIATE FRAMEWORK FOR BROADBAND ACCESS TO THE INTERNET OVER WIRELINE FACILITIES, CC Docket No. 02-33, July 1, 2002.

[56] High Tech Broadband Coalition, Cable Modem Proceeding, *supra* note 55, at 9.

[57] Lee W. McKnight, *Internet Business Models: Creative Destruction as Usual*, in CREATIVE DESTRUCTION: BUSINESS SURVIVAL STRATEGIES IN THE GLOBAL INTERNET ECONOMY (Lee W. McKnight, Paul M. Vaaler, & Raul L. Katz, eds., 2001), at 45.

[58] Mark Buchanan, NEXUS: SMALL WORLDS AND THE GROUNDBREAKING THEORY OF NETWORKS (2002), at 76.

[59] Id., at 76-77.

[60] Joel Mokyr, *Innovation in an Historical Perspective: Tales of Technology and Evolution*, in TECHNOLOGICAL INNOVATION AND ECONOMIC PERFORMANCE (Benn Steil, David G. Victor & Richard R. Nelson, eds., 2002).

[61] Id., at 42.

[62] Id., at 141.

[63] Id., at 42.

[64] Harold Evans, THE AMERICAN CENTURY (1998).

[65] This understanding of common carriage is quite prevalent, as an analysis prepared by Morgan Stanley Dean Witter, THE DIGITAL DECADE, April 6, 1999, at 177-178, noted in describing common carriers:

> Generally, they are involved in the sale of infrastructure services in transportation and communications. The legal principle of common carriage is used to ensure that no customer seeking service upon reasonable demand, willing and able to pay the established prices, however set, would be denied lawful use of the service or would otherwise be discriminated against…
>
> Significantly, a carrier does not have to claim to be a common carrier to be treated as such under the law: a designation of common carriage depends upon a carrier's actual business practices, not its charter... .
>
> Common carriage is also thought to be an economically efficient response to reduce the market power of carriers through government regulation, preventing discrimination and/or censorship and promoting competition. It is also said to promote the basic infrastructure, reduce transaction costs from carrier to carrier, and extend some protections for First Amendment rights from the public to the private sector.

[66] Cited in James B. Speta, *A Common Carrier Approach to Internet Interconnection*, 54 FED. COMM. L.J., 254 (2002).

[67] Andrew Odlyzko, PRICING AND ARCHITECTURE OF THE INTERNET: HISTORICAL PERSPECTIVES FROM TELECOMMUNICATIONS AND TRANSPORTATION (2003), notes price discrimination between classes of goods but not in access to the network. He also notes the central role of government policy in establishing rights of access and setting rates (*see* also Hal Varian, MARKETS FOR PUBLIC GOODS [January 2003]; D. Davis, SHINE YOUR LIGHT ON ME, December 23, 2002 (http://D-squareddiest.blogpost.org/2002_12_22_d-squareddigest_archives.html#86435321)).

[68] Hockett v. State of Indiana, 1886, cited in Speta, *Common Carrier*, *supra* note 66, at 262.

[69] Cited in Alfred Kahn, THE ECONOMICS OF REGULATION: PRINCIPLES AND INSTITUTIONS (1988), at 55.

[70] Speta, *The Vertical Dimension*, *supra* note 9, at 975; Phil Weiser, *Paradigm Changes*, *supra* note 9.

[71] Mokyr, *Innovation*, *supra* note 60, at 42-43.

[72] Albert-Laszlo Barabasi, LINKED (2002); Buchanan, NEXUS, *supra* note 58; Duncan Watts, SIX DEGREES: THE SCIENCE OF A CONNECTED AGE (2003).

[73] Barabasi, LINKED, *supra* note 72, at 110.

[74] Id., at 110.

[75] Id., at 113.

[76] Id., at 232.

[77] The biological analogy is strong here, since "cells sustain a multitude of functions – i.e., multitask – thanks to a discrete modular organization… [T]he network behind the cell is fragmented into groups of diverse molecules, or modules, each module being responsible for a different cellular function." (Barabasi, LINKED, *supra* note 72, at 231).

[78] Barabasi, LINKED, *supra* note 72, at 236.

[79] Barabasi, LINKED, *supra* note 72, at 86.

[80] Watts, SIX DEGREES, *supra* note 72, at 277.

[81] WEBSTER'S THIRD NEW INTERNATIONAL DICTIONARY (1986), at 2102.

[82] Id., at 277.

[83] Id., at 277.

[84] Id., at 277.

[85] Buchanan, NEXUS, *supra* note 58, at 58.

[86] Watts, SIX DEGREES, *supra* note 72, at 279.

[87] Buchanan, NEXUS, *supra* note 58, at 43.

[88] Watts, SIX DEGREES, *supra* note 72, at 286.

[89] Barabasi, LINKED, *supra* note 72, at 236.

[90] Watts, SIX DEGREES, *supra* note 72, at 279-80.

[91] Searchability in problem solving implies another characteristic of the network, feedback. Steven Johnson, EMERGENCE: THE CONNECTED LIVES OF ANTS, BRAINS, CITIES AND SOFTWARE (2001), at 134, frames the explanation in terms of neural networks asking, "why do these feedback loops and reverberating circuits happen?"

[92] Watts, SIX DEGREES, *supra* note 72, at 56.

[93] Id., at 288.

[94] Id., at 279.

[95] Id., at 288.

[96] Barabasi. LINKED, *supra* note 72, at 148.

[97] Berners-Lee, WEAVING THE WEB, *supra* note 18, at 211.

[98] Barabasi, LINKED, *supra* note 72, at 129.

[99] Watts, SIX DEGREES, *supra* note 72, at 244.

[100] Id., at 230-231.

[101] Id., at 241.

[102] Id., at 287.

[103] Buchanan, NEXUS, *supra* note 58, at 69.

[104] Watts, SIX DEGREES, *supra* note 72, at 287.

[105] Ashish Arora, Andrea Fosfuri & Alfonso Gamardella, MARKETS FOR TECHNOLOGY: THE ECONOMICS OF INNOVATION AND CORPORATE STRATEGY (2001), at 112.

[106] Id., at 106.

[107] Id., at 106.

[108] Id., at 103. The efficient solution emerges in a direct analogy to the biological cell. "A work cell is a small group of technical and human resources closely located and dedicated to processing a family of similar parts, products, information deliverables or services." Comparing work cells to an assembly line underscores the critical superiority of modular design. Real cells have "more flexibility in that they can produce a range of service or products within a family… [and] normally perform a broader range of tasks." They are a "hybrid that combines the focus of an assembly line with the flexibility of a job shop functional arrangement."

> [A] "real cell" links tasks and those who perform them in terms of space, time, and information.
>
> *Space Linkages:* Cell resources must be located closely together. Moreover proximal human and technical resources must include all the necessary skill sets and processing capabilities a product or service family will require…
>
> *Time Linkages:* both the physical layout of the cell and its operating routines must permit work to flow expediently from one station to the next…

Information Linkages: A cell should be configured and operated such that information about the work being processed flows easily.

[109] John Seely Brown & Paul Duguid, *Mysteries of the Region: Knowledge Dynamics in Silicon Valley*, in THE SILICON VALLEY EDGE: A HABITAT FOR INNOVATION AND ENTREPRENEURSHIP (Chong-Moon Lee, William F. Miller, Marguerite Gong Hancock & Henry S. Rowen, eds., 2000), at 29.

[110] Id., at 31-32.

[111] Id., at 32.

[112] Id., at 32.

[113] Annalee Saxenian, *The Origins and Dynamics of Production Networks in Silicon Valley*, in UNDERSTANDING SILICON VALLEY (Martin Kenney, ed., 2000), at 144.

[114] Id., at 145.

[115] David B. Audretsch & Charles F. Bonser, *Regional Policy in the New Economy*, in THE NEW ECONOMY AND ECONOMIC GROWTH IN EUROPE AND THE US (David B. Audretsch & Paul J.J. Welfens, eds., 2002), at 130.

[116] Chong-Moon Lee, William F. Miller, Marguerite Gong Hancock & Henry S. Rowen, "The Silicon Valley Habitat," in THE SILICON VALLEY EDGE: A HABITAT FOR INNOVATION AND ENTREPRENEURSHIP (Chong-Moon Lee, William F. Miller, Marguerite Gong Hancock & Henry S. Rowen, eds., 2000), at 6.

[117] Eric Von Hippel, *Economics of Product Development by Users: The Impact of 'Sticky' Local Information,* MANAGEMENT SCIENCE (44: 1998), at 642.

[118] Arora, MARKETS FOR TECHNOLOGY, *supra* note 105, at 112.

[119] Id., at 112.

[120] Id., at 113.

[121] Id., at 104-105.

[122] Id., at 255.

[123] David J. Teece, MANAGING INTELLECTUAL CAPITAL (2000), at 71.

[124] Werner Roger, *Structure Changes and New Economy in the EU and the US,* in THE NEW ECONOMY AND ECONOMIC GROWTH IN EUROPE AND THE US (David B. Audretsch & Paul J.J. Welfens, eds., 2002), at 18.

[125] Mark A. Carree, *The Effect of Restructuring the Organization of Production on Economic Growth*, in THE NEW ECONOMY AND ECONOMIC GROWTH IN EUROPE AND THE US (David B. Audretsch & Paul J.J. Welfens, eds., 2002), at 205… 210.

[126] Arora, MARKETS FOR TECHNOLOGY, *supra* note 105, at 113.

[127] Id., at 263.

[128] Id., at 263.

[129] Id., at 263-64.

[130] Annabelle Gawer & Michael A. Cusumano, PLATFORM LEADERSHIP: HOW INTEL, MICROSOFT AND CISCO DRIVE INNOVATION (2002), at 55-56.

[131] Id., at 55.

[132] Id., at 51.

[133] Id., at 52.

[134] Saxenian, *The Origins and Dynamics, supra* note 113, at 148.

[135] Brown & Duguid, *Mysteries of the Region, supra* note 109, at 32.

[136] Gawer & Cusumano, PLATFORM LEADERSHIP, *supra* note 130, at 28-29.

[137] Berners-Lee, WEAVING THE WEB, *supra* note 18, at 72-73.

[138] Michael L. Katz & Carl Shapiro, *System Competition and Network Effects*, 8 J. ECON. PERSPECTIVES 93, 105-6 (1994), argue that competition between incompatible systems is possible, depending on consumer heterogeneity. Paul Belleflamme, *Stable Coalition Structures with Open Membership and Asymmetric Firms*, 30 GAMES & ECON. BEHAVIOR 1, 1-3 (2000), and Berd Woeckener, *The Competition of User Networks: Ergodicity, Lock-ins, and Metastability,* 41 J. ECON. BEHAVIOR & ORG. 85, 86-7 (2000), reach a similar conclusion in a different theoretic framework. Timothy F. Bresnahan & Shane Greenstein, *Technological Competition and the Structure of the Computer Industry*, 47 J. INDUSTRIAL ECON. 1, 5-8 (1999), envision a great deal of competition within the layers of a platform and across layers in relatively short periods of time. The description of IBM's mainframe platform provided by Franklin M. Fisher, *The IBM and Microsoft Cases: What's the Difference?,* 90 AM. ECON. REV. 180, 183 (1999), stresses both these points. See also Daniel L. Rubinfeld, *Antitrust Enforcement in Dynamic Network Industries,* 43 ANTITRUST BULL. 859, 873-75 (1998); Willow A. Sheremata,

"*New" Issues in Competition Policy Raised by Information Technology Industries*, 43 ANTITRUST BULL. 547, 573-74 (1998); Timothy Bresnahan, *The Economics of the Microsoft Case* (available from the author); Steven C. Salop and R. Craig Romaine, *Preserving Monopoly: Economic Analysis, Legal Standards, and Microsoft*, GEO. MASON L. REV. (1999).

[139] William G. Shepherd, THE ECONOMICS OF INDUSTRIAL ORGANIZATION (3d ed., 1990), at 289-90.

[140] *See* Martin K. Perry, *Vertical Integration: Determinants and Effects*, in HANDBOOK OF INDUSTRIAL ORGANIZATION (Richard Schmalensee & Robert D. Willig, eds., 1989), at 183, 247; F. Michael Scherer & David Ross, INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE (1990), at 526.

[141] Perry, *Vertical Integration*, *supra* note 140, at 246; s*ee* also SHEPHERD, ECONOMICS , *supra* note 139, at 294.

[142] Scherer & Ross, INDUSTRIAL MARKET STRUCTURE, *supra* note 140, at 526.

[143] Other behavior effects may occur. For example, collusion, mutual forbearance and reciprocity may exist where the small number of interrelated entities in the industry recognize and honor each others' spheres of influence. The final behavioral effect is to trigger a rush to integrate and concentrate. Being a small independent entity at any stage renders the comp any extremely vulnerable to a variety of attacks. *See* Shepherd, ECONOMICS, *supra* note 139, at 290.

[144] Langlois, *Technology Standards, supra* note 19, at 52, "The owner of a dominant standard may thus want to manipulate the standard in ways that close off the possibilities for a competitor to achieve compatibility. This has a tendency to retard the generational advance of the system."

[145] Timothy Wu & Lawrence Lessig, *Ex Parte Submission* in CS DOCKET *No. 02-52,* August 22, 2003, at 7-8.

[146] *See id*. *See* also Franklin M. Fisher, *Innovation and Monopoly Leveraging*, in DYNAMIC COMPETITION AND PUBLIC POLICY: TECHNOLOGY, INNOVATION, AND ANTITRUST ISSUES (Jerry Ellig, ed., 2001), at 138.

[147] *See* Joseph Farrell & Garth Saloner, *Installed Base and Compatibility: Innovation, Product Preannouncements, and Predation*, 76 AM. ECON. REV. 940, 948-51 (1986); Michael L. Katz & Carl Shapiro, *Product Introduction with Network Externalities*, 40 J. INDUS. ECON. 55, 73 (1992); Richard Makadok, *Can First-Mover and Early-Mover Advantages Be Sustained in an Industry with Low Barriers to Entry/Imitation?,* 19 STRATEGIC MGMT. J. 683, 685-86 (1998); Ulrich Witt, *"Lock-in" vs. "Critical Masses"– Industrial Change Under Network Externalities*, 15 INT'L J. INDUS. ORG. 753, 768-69 (1997); Robin Mansell, *Strategies for Maintaining Market Power in the Face of Rapidly Changing Technologies*, 31 J. ECON. ISSUES 969, 970 (1997).

[148] *See* Melissa A. Schilling, *Technological Lockout: An Integrative Model of the Economic and Strategic Factors Driving Technology Success and Failure*, 23 ACAD. MGMT. REV. 267, 276 (1998).

[149] *See* Sheremata, *"New" Issues in Competition Policy, supra* note 138, 547, 573-74; Glenn A. Woroch, et al., *Exclusionary Behavior in the Market for Operating System Software: The Case of Microsoft*, in OPENING NETWORKS TO COMPETITION: THE REGULATION AND PRICING OF ACCESS (David Gabel & David F. Weiman, eds., 1998), at 221.

[150] Sheremata, *"New" Issues in Competition Policy*, *supra* note 138, at 560-61; *see* also Charles H. Ferguson, HIGH ST@KES, NO PRISONERS: A WINNER'S TALE OF GREED AND GLORY IN THE INTERNET WARS (1999), at 307; Mark A. Lemley & David McGowan, *Could Java Change Everything? The Competitive Propriety of a Proprietary Standard,* ANTITRUST BULL., 43 (1998), at 715, 732-33; Joseph P. Guiltinan, *The Price Bundling of Services: A Normative Framework,* J. MKTG. 74 (April 1987); Lester Telser, *A Theory of Monopoly of Complementary Goods*, 52 J. BUS. 211 (1979); Richard Schmalensee, *Gaussian Demand and Commodity Bundling*, 57 J. BUS. 211 (1984).

[151] Joseph Farrell & Michael L. Katz, *The Effects of Antitrust and Intellectual Property Law on Compatibility and Innovation*, 43 ANTITRUST BULL. 609, 643-50, (1998); Sheremata, *"New" Issues in Competition Policy, supra* note 138, at 547, 573-74.

[152] Makadok, *First-Mover and Early-Mover Advantages, supra* note 147, at 685.

[153] David B. Yoffie, *CHESS and Competing in the Age of Digital Convergence*, in COMPETING IN THE AGE OF DIGITAL CONVERGENCE (David B. Yoffie, ed., 1997), at 1, 27; *see* also Robert E. Dansby & Cecilia Conrad, *Commodity Bundling*, 74 AM. ECON. REV. 377 (1984).

[154] Carmen Matutes & Pierre Regibeau, *Compatibility and Bundling of Complementary Goods in a Duopoly*, 40 J. INDUS. ECON. 37 (1992).

[155] *See id*. *See* also Guiltinan, *The Price Bundling of Services, supra* note 150; Telser, *A Theory of, supra* note 150; Richard Schmalensee, *Gaussian Demand and Commodity Bundling*, 57 J. BUS. 211 (1984).

[156] Jay Pil Choi, *Network Externality, Compatibility Choice, and Planned Obsolescence*, 42 J. INDUS. ECON. 167, 171-73 (1994).

[157] Glenn Ellison & Drew Fudenberg, *The Neo-Luddite's Lament: Excessive Upgrades in the Software Industry*, 31 RAND J. ECON. 253 (2000); Drew Fudenberg & Jean Tirole, *Upgrades, Trade-ins, and Buybacks*, 29 RAND J. ECON. 235, 235-36 (1998).

[158] *See* K. Sridhar Moorthy, *Market Segmentation, Self Selection, and Product Lines Design*, 3 MKTG. SCI. 256 (1985); Marcel Thum, *Network Externalities, Technological Progress, and the Competition of Market Contract*, 12 INT. J. INDUS. ORG. 269 (1994).

[159] Schilling, *Technological Lockout, supra* note 148, at 267, 268, 270; Willow A. Sheremata, *Barriers to Innovation: A Monopoly, Network Externalities, and the Speed of* Innovation, 42 ANTITRUST BULL. 937, 941, 964, 967 (1997); Robin Cowan, *Tortoises and Hares: Choice Among Technologies of Unknown Merit*, 101 ECON. J. 807, 808 (1991); Dominique Foray, *The Dynamic Implications of Increasing Returns: Technological Change and Path Dependent Efficiency*, 15 INT. J. INDUSTRIAL ORG. 733, 748-49 (1997); Joseph Farrel & Garth Saloner, *Standardization, Compatibility, and* Innovation, 16 RAND J. ECON. 70-83 (1986).

[160] Jeffrey Church & Neil Gandal, *Complementary Network Externalities and Technological Adoption*, 11 INT'L J. INDUS. ORG. 239, 241 (1993); Chou Chien-fu & Oz Shy, *Network Effects Without Network Externalities*, 8 INT'L J. INDUS. ORG. 259, 260 (1990).

[161] See Michael Katz & Carl Shapiro, *Antitrust and Software Markets*, in COMPETITION, INNOVATION AND THE MICROSOFT MONOPOLY: ANTITRUST AND THE DIGITAL MARKETPLACE (Jeffrey A. Eisenach & Thomas M. Lenard, eds., 1999), at 70-80; Lansuz A. Ordover & Robert D. Willig, *Access and Bundling in High Technology Markets*, in COMPETITION, INNOVATION AND THE MICROSOFT MONOPOLY: ANTITRUST AND THE DIGITAL MARKETPLACE (Jeffrey A. Eisenach & Thomas M. Lenard, eds., 1999); Rubinfeld, *Antitrust Enforcement, supra* note 138, at 877-81; Steven C. Salop, *Using Leverage to Preserve Monopoly*, in COMPETITION, INNOVATION AND THE MICROSOFT MONOPOLY: ANTITRUST AND THE DIGITAL MARKETPLACE (Jeffrey A. Eisenach & Thomas M. Lenard, eds., 1999).

[162] Daniel L. Rubinfeld & John Hoven, *Innovation and Antitrust Enforcement*, in DYNAMIC COMPETITION AND PUBLIC POLICY: TECHNOLOGY, INNOVATION, AND ANTITRUST ISSUES (Jerry Ellig, ed., 2001), at 65, 75-76. T. Randolph Beard, George S. Ford & Lawrence J. Spiwak, *Why ADCo? Why Now: An Economic Exploration into the Future of Industry Structure for the "Last Mile" in Local Telecommunications Markets (*Phoenix Center, November 2001); Computer Science and Telecommunications Board, National Research Council, BROADBAND, BRINGING HOME THE BITS (2002), at 23; 152-154; Anupam Banerjee & Marvin Sirvu, "Towards Technologically and Competitively Neutral Fiber to the Home (FTTH) Infrastructure," paper presented at *Telecommunications Policy Research Conference, 2003;* Stagg Newman, *Broadband Access Platforms for the Mass Market,* paper presented at *Telecommunications Policy Research Conference, 2003*.

[163] National Research Council, BROADBAND, *supra* note 162.

[164] Implementation of Section 11 of the Cable Television Consumer Protection and Competition Act of 1992, *Further Notice of Proposed Rulemaking,* 16 F.C.C.R. 17,312, ¶ 36 (2001) (citation omitted). *See also* 47 C.F.R. §§ 21, 73 & 76 (2001).

[165] *See* Phil Weiser, *Networks Unplugged: Toward a Model of Compatibility Regulation Between Communications Platforms* (paper presented at *Telecommunications Policy Research Conference*, Oct. 27, 2001), *at* http://www.arxiv.org/html/cs/0109070 (last visited Jan. 24, 2003), stating "in markets where more than one network standard battle it out in the marketplace, users can benefit from a greater degree of dynamism."

[166] Lessig, FUTURE , *supra* note 8, Ch. 8.

[167] Id., at Ch. 10.

[168] Scherer & Ross, INDUSTRIAL MARKET STRUCTURE, *supra* note 140, at 31.

[169] *See* Stan J. Liebowitz & Stephen E. Margolis, WINNERS, LOSERS & MICROSOFT: COMPETITION AND ANTITRUST IN HIGH TECHNOLOGY (2001), using the term 'serial monopoly' (as do a bevy of other Microsoft supported experts); Mark Cooper, *Antitrust as Consumer Protection in the New Economy: Lessons from the Microsoft Case*, 52 HASTINGS L.J. 813 (2001), pointing out that there is nothing serial in Microsoft's monopolies. Rather, Microsoft conquers market after market using leverage and anticompetitive tactics, never relinquishing any of its previous monopolies.

[170] Weiser, *Networks Unplugged*, *supra* note 165, at 29:

> ISPs cannot compete on the core value proposition in a broadband world unless they are offering a facilities-based service that enables them to compete on price and quality with a cable provider of Internet service. To the extent that a cable provider desires to find new marketing channels, it may well strike arrangements with ISPs to assist on that score, but the ISPs are not competing on the core product.
>
> At best, the ISPs are able to offer differentiated content on the portal screen, added security features, more reliable privacy policies and the like.

[171] Scherer & Ross, INDUSTRIAL MARKET STRUCTURE, *supra* note 140, at 660:

> Viewed in their entirety, the theory and evidence [in support of monopoly power] suggest a threshold concept of the most favorable climate for rapid technological change. A bit of monopoly power in the form of structural concentration is conducive to innovation, particularly *when advances in the relevant knowledge base occur slowly*. But very high concentration has a positive effect only in rare cases, and more often it is apt to retard progress by restricting the number of independent sources of initiative and by dampening firms' incentive to gain market position through accelerated R&D. Likewise, given the important role that technically audacious newcomers play in making radical innovations, it seems important that barriers to new entry be kept at modest levels. Schumpeter was right in asserting that perfect competition has no title to being established as the model of dynamic efficiency. But his less cautious followers were wrong when they implied that powerful monopolies and tightly knit cartels had any strong claim to that title. What is needed for rapid technical progress is a subtle blend of competition and monopoly, with more emphasis in general on the former than the latter, and with the role of monopolistic elements diminishing when rich technological opportunities exist.

[172] Rubinfeld & Hoven, *Innovation and Antitrust Enforcement*, supra note 162, at 65, 75-76:

> One policy implication for antitrust is the need to preserve a larger number of firms in industries where the best innovation strategy is unpredictable. . . . Another implication is . . . that "Technical progress thrives best in an environment that nurtures a diversity of sizes and, perhaps especially, that keeps barriers to entry by technologically innovative newcomers low." . . . A third implication is the awareness that dominant firms may have an incentive to act so as to deter innovative activities that threaten the dominant position.

[173] United States v. Microsoft, 253 F.3d 34, 103 (D.C. Cir. 2001) (*per curiam*); Mark Cooper, *Antitrust as Consumer Protection*, *supra* note 169.

[174] Langlois, *Technology Standards*, *supra* note 19, at 215:

> In the case of the personal computer, the rise of a single dominant – but largely open and nonproprietary – standard focused innovation in modular directions. [I]t is the ensuing rapid improvement in components, including not only the chips but various peripheral devices like hard disks and modems, as well as the proliferation of applications software, that has led to the rapid fall in the quality-adjusted price of the total personal computer system.

[175] Yoffie, *CHESS and Competing*, supra note 153, at 21; *see* also Bresnahan & Greenstein, *Technological Competition*, supra note 138, at 36-37; Katz & Shapiro, *System Competition*, supra note 138, at 103.

[176] Schilling, *Technological Lockout*, *supra* note 148, at 280-81.

[177] Katz & Shapiro, *Antitrust and Software Markets*, *supra* note 161, at 424.

[178] *See* generally id.; Jay Pil Choi, *Network Externalities, Compatibility Choice and Planned Obsolescence*, 42 J. INDUS. ECON. 167 (1994).

[179] Robin Mansell, *Strategies for Maintaining Market Power in the Face of Rapidly Changing Technologies*, 31 J. ECON. ISSUES 969, 970 (1997).

[180] Schilling, *Technological Lockout*, *supra* note 148, at 274.

[181] Sheremata, *Barriers to Innovation*, supra note 159, at 965.

[182] Shapiro & Varian, INFORMATION RULES, *supra* note 19, at 22-23.

[183] Bresnahan & Greenstein, *Technological Competition*, supra note 138, at 36-37; Farrell & Katz, *The Effect of Antitrust*, *supra* note 151; Katz & Shapiro, *System Competition*, *supra* note 138, at 109-12; Carmen Matutes & Pierre Regibeau, *Mix and Match: Product Compatibility Without Network Externalities*, 19 RAND J. OF ECON. 221-233 (1988).

[184] Lemley & McGowan, *Could Java Change Everything?, supra* note 154, at 715; Mark A. Lemley & David McGowan, *Legal Implications of Network Effects*, 86 CAL. L. REV. 479, 516-18 (1998).

[185] *See* Weiser, *Networks Unplugged, supra* note 165, at n.136 (suggesting that we "ask whether, 18 years after the rollout of this technology, will consumers benefit from a number of alternative providers. . ." He then answers the question by looking at the wrong industry (cellular, instead of cable)).

[186] Time Warner Inc., 123 F.T.C. 171 (1997) [hereinafter *Time Warner/Turner/TCI*]. In the Time Warner/Turner/TCI merger analysis, the Federal Trade Commission found that entry into the distribution market was difficult in part because of vertical leverage.

[187] Daniel L. Rubinfeld & Hal. J. Singer, *Open Access to Broadband Networks: A Case Study of the AOL/Time Warner Merger*, 16 BERKELEY TECH. L.J. 631 (2001).

[188] AT&T in Canada before it became the nation's largest cable company. S*ee* AT&T Canada Long Distance Services, *Comments of AT&T Canada Long Distance Services Company*, REGULATION OF CERTAIN TELECOMMUNICATIONS SERVICE OFFERED BY BROADCAST CARRIERS, the Canadian Radio-Television and Telecommunications Commission, Telecom Public Notice CRTC 96-36: (1997). The AT&T policy on open access after it became a cable company was first offered in a Letter from David N. Baker, Vice President, Legal & Regulatory Affairs, Mindspring Enterprises, Inc., James W. Cicconi, General Council and Executive Vice President, AT&T Corp., and Kenneth S. Fellman, Esq., Chairman, FCC Local & State Government Advisory Committee, to William E. Kennard, Chairman of FCC (Dec. 6, 1999), *available at* http://www.fcc.gov/mb/attmindspringletter.txt. Virtually no commercial activity took place as a result of the letter, which was roundly criticized. Subsequently their activities were described in Peter S. Goodman, *AT&T Puts Open Access to a Test: Competitors Take Issue with Firm's Coveted First-Screen Presence,* WASH. POST, Nov. 23, 2000, at E1. AT&T in the U.S. in situations where it does not possess an advantage of owning wires, *see AT&T Corp., Reply Comments*, DEPLOYMENT OF WIRELINE SERVS. OFFERING ADVANCED TELECOMMS. CAPABILITY CC Docket No. 98-147 (1998); *see AT&T Corp., Reply Comments,* OPPOSITION TO SOUTHWESTERN BELL TEL. CO. SECTION 271 APPLICATION FOR TEX., APPLICATION OF SBC COMMUNICATIONS INC., SOUTHWESTERN BELL TEL. CO., & SOUTHWESTERN BELL COMMUNICATIONS SERVS., INC. D/B/A SOUTHWESTERN BELL LONG DISTANCE FOR PROVISION OF IN-REGION INTERLATA SERVICES. IN TEXAS (2000), *at* http://gullfoss2.fcc.gov/ prod/ecfs/comsrch_v2.cgi .

[189] *See America Online, Inc., Comments*, TRANSFER OF CONTROL OF FCC LICENSES OF MEDIAONE GROUP INC., TO AT&T CORP., CS Docket 99-251 (filed Aug. 23, 1999) (providing, at the federal level, AOL's most explicit analysis of the need for open access); America Online, Inc., *Open Access Comments of America Online, Inc.*, before the DEPARTMENT OF TELECOMMUNICATIONS AND INFORMATION SERVICES, SAN FRANCISCO, October 27, 1999 (on file with author).

[190] Jerry A. Hausman, et al., *Residential Demand for Broadband Telecommunications and Consumer Access to Unaffiliated Internet Content Providers,* 18 YALE J. ON REG. (2001).

[191] John B. Hayes, Jith Jayaratne, and Michael L. Katz, *An Empirical Analysis of the Footprint Effects of Mergers Between Large ILECS*, citing "Declaration of Michael L. Katz and Steven C. Salop," submitted as an attachment to PETITION TO DENY OF SPRING COMMUNICATIONS COMPANY L.P, IN AMERITECH CORP. & SBC COMMUNICATIONS, INC., FOR CONSENT TO TRANSFER OF CONTROL, CC Dkt. No. 98-141 (filed Oct. 15, 1998) and PETITION TO DENY OF SPRING COMMUNICATIONS COMPANY L.P, IN GTE CORPORATION AND BELL ATLANTIC CORP. FOR CONSENT TO TRANSFER OF CONTROL, CC Docket. No. 98-184 (filed Nov. 23, 1998) (on file with author).

[192] Sanford C. Bernstein and McKinsey and Company, *Broadband!*, January, 2000 (on file with author); Merrill Lynch, AOL *Time Warner*, February 23, 2000; Paine Webber, *AOL Time Warner: Among the World's Most Valuable Brands*, March 1, 2000; Goldman Sachs, *America Online/Time Warner: Perfect Time-ing*, March 10, 2000 (on file with author).

[193] Earthlink, the first ISP to enter into negotiations with cable owners for access, has essentially given up and is vigorously seeking an open access obligation. *See* Notice of Ex Parte, Presentation Regarding the Applications of America Online, Inc. & Time Warner Inc. for Transfers of Control CS Docket No 00-30 (filed Oct. 18, 2000), *available at* http://gullfoss2.fcc.gov/prod/ecfs/comsrch_v2.cgi; NorthNet, Inc., An Open Access Business Model For Cable Systems: Promoting Competition & Preserving Internet Innovation On A Shared, Broadband Communications Network, Ex Parte, *Application of America Online, Inc. & Time Warner, Inc. for Transfers of Control*, F.C.C., CS-Docket No. 0030, October 16, 2000.

[194] *See* American Cable Association, *Comments*, IN RE IMPLEMENTATION OF THE CABLE TELEVISION CONSUMER PROTECTION & COMPETITION ACT OF 1992, DEVELOPMENT OF COMPETITION IN VIDEO PROGRAMMING DISTRIBUTION: SECTION 628(C)(5) OF THE COMMUNICATIONS ACT: SUNSET OF EXCLUSIVE CONTRACT PROHIBITION, CS Docket No. 01-290 (filed Dec. 3, 2001) *available at* http://gullfoss2.fcc.gov/prod/ecfs/comsrch_v2.cgi.

[195] *See* Legal Rights Satellite Org., *Communications Convergence of Broadcasting and Telecommunications Services* (arguing that there were barriers to entry into physical facilities), at http://www.legal-rights.org/Laws/convergence.html (last visited Jan. 17, 2003):

> In the opinion of AT&T Canada LDS, the supply conditions in broadband access markets are extremely limited. There are significant barriers to entry in these markets including lengthy construction periods, high investment requirements and sunk costs, extensive licensing approval requirement (including the requirements to obtain municipal rights-of-way) . . . Under these circumstances, the ability for new entrants or existing facilities-based service providers to respond to non-transitory price increases would be significantly limited, not to mention severely protracted.

[196] Hausman, et al., *Residential Demand for* Broadband, *supra* note 190, at 129, 134.

[197] Mark Cooper, *The Importance of ISPs in The Growth of The Commercial Internet: Why Reliance on Facility-Based Competition Will Not Preserve Vibrant Competition and Dynamic Innovation on the High-Speed Internet*, *Attachment A to Comments of the Texas Office of People's Council*, *et al.*, APPROPRIATE FRAMEWORK FOR BROADBAND ACCESS TO THE INTERNET OVER WIRELINE FACILITIES UNIVERSAL SERVICE OBLIGATIONS OF BROADBAND PROVIDERS COMPUTER III FURTHER REMAND PROCEEDINGS: BELL OPERATING COMPANY PROVISION OF ENHANCED SERVICES; 1998 BIENNIAL REGULATORY REVIEW – REVIEW OF COMPUTER III AND ONA SAFEGUARDS AND REQUIREMENTS, Federal Communications Commission, CC Dockets Nos. 02-33, 98-10. 95-20 (July 1, 2002), at 135.

[198] *See* Langlois, *Technology Standards, supra* note 19, at 195.

[199] *See* Mark Cooper, *Open Access to the Broadband Internet: Technical and Economic Discrimination in Closed, Proprietary Networks*, 71 U. COLO. L. REV. 1013 (2000).

[200] Bernstein, *Broadband!*, *supra* note 192, at 18, 21:

> [T]he current set of alternatives for reaching customers with broadband connections is inadequate. At least for the time being, cable is closed, meaning that much of the value is, in effect, ceded to the platform rather than captured by the content/applications providers.
>
> [B]roadband access platforms are the anchor points for much of the value at stake and vehicles for accessing new revenue streams. Furthermore, access is currently a bottleneck, and access winners have the potential to leverage their privileged position to ensure long-term value creation.

[201] That is exactly what AOL said about AT&T, when AOL was a nonaffiliated ISP. *See AOL, Transfer of Control*, *supra* note 189, at 13.

[202] Hausman, et al., *Residential Demand for Broadband, supra* note 190, at 135.

[203] Id. at 156.

[204] Id. at 135.

[205] *AT&T Canada*, *Comments of AT&T Canada*, *supra* note 188, at 12.

> Each of these pronouncements made by regulators, policy makers and individual members of the industry reflects the strongly held view that access to the underlying facilities is not only necessary because of the bottleneck nature of the facilities in question, but also because it is critical for the development of competition in the provision of broadband services. AT&T Canada LDS shares this view and considers the control exercised by broadcast carriers over these essential inputs is an important factor contributing to the dominance of broadcast carriers in the market for access services.

[206] Id. at 8-9.

> By contrast, the telephone companies have just begun to establish a presence in the broadband access market and it will likely take a number of years before they have extensive networks in place. This lack of significant market share, however, is overshadowed by their monopoly position in the provision of local telephony services

Id. at 8.

> [I]n any event, even if it could be argued that the telephone companies are not dominant in the market for broadband access services because they only occupy a small share of the market, there are a number of compelling reasons to suggest that measures of market share are not overly helpful when assessing the dominance of telecommunications carriers in the *access* market.

Id. at 9 (emphasis in original).

[207] Id. at 24.

[208] Id. at 12.

> Because there are and will be many more providers of content in the broadband market than there are providers of carriage, there always will be more service providers than access providers in the market. Indeed, even if all of the access providers in the market integrated themselves vertically with as many service providers as practically feasible, there would still be a number of service providers remaining which will require access to the underlying broadband facilities of broadcast carriers.

[209] AOL, *Comments, Transfer of Control*, *supra* note 189, at 14.

> [A]n open access requirement] would allow ISPs to choose between the first-mile facilities of telephone and cable operators based on their relative price, performance, and features. This would spur the loop-to-loop, facilities-based competition contemplated by the Telecommunications Act of 1996, thereby offering consumers more widespread availability of Internet access; increasing affordability due to downward pressures on prices; and a menu of service options varying in price, speed, reliability, content and customer service.
>
> Another indication that the availability of alternative facilities does not eliminate the need for open access policy can be found in AOL's conclusion that the policy should apply to both business and residential customers. If ever there was a segment in which the presence of two facilities competing might alleviate the need for open access requirement, the business segment is it. AOL rejected the idea.

Id. at 1-2.

[210] *See* Mark Cooper, *Breaking the Rules*, attached to Petition to Deny of Consumers Union, Consumer Federation of America and Media Access Project, Applications for Consent to Transfer of Control of Licenses, MediaOne Group, Inc. Transferor to AT&T Corp., Transferee, CS 99-251 (filed August 23, 1999) (on file with author).

[211] *See* Bernstein, *Broadband!*, *supra* note 192, at 30, 33, 50-51.

[212] *See id.* at 7; Merrill Lynch, AOL *Time Warner*, *supra* note 192, at 33.

[213] Hausman, et al., *Residential Demand for Broadband*, *supra* note 190, at 158.

[214] Id. at 159.

[215] *AT&T Canada*, *Comments of AT&T Canada*, *supra* note 188.

[216] Hausman, et al., *Residential Demand for Broadband*, *supra* note 190, at 160-62.

[217] *AT&T SBC*, *supra* note 50.

[218] *AT&T Canada*, *Comments of AT&T Canada*, *supra* note 188, at 15-16.

> The dominant and vertically integrated position of cable broadcast carriers requires a number of safeguards to protect against anticompetitive behaviour. These carriers have considerable advantages in the market, particularly with respect to their ability to make use of their underlying network facilities for the delivery of new services. To grant these carriers unconditional forbearance would provide them with the opportunity to leverage their existing networks to the detriment of other potential service providers. In particular, unconditional forbearance of the broadband access services provided by cable broadcast carriers would create both the incentive and opportunity for these carriers to lessen competition and choice in the provision of broadband service that could be made available to the end customer . . .
>
> The telephone companies also have sources of market power that warrant maintaining safeguards against anticompetitive behaviour. For example, telephone companies are still overwhelmingly dominant in the local telephony market and, until this dominance is

diminished, it would not be appropriate to forebear unconditionally from rate regulation of broadband access services.

[219] *AOL, Open Access Comments*, *supra* note 51, at 8.

[220] Hayes, et al., *Empirical Analysis*, *supra* note 191, at 1.

[221] *See* Bernstein, *Broadband!*, *supra* note 192, at 57.

> Thus, the real game in standards is to reach critical mass for your platform without giving up too much control. This requires a careful balance between openness (to attract others to your platform) and control over standards development (to ensure an advantaged value-capture position). Of course, the lessons of Microsoft, Cisco, and others are not lost on market participants, and these days no player will willingly cede a major standards-based advantage to a competitor. Therefore, in emerging sectors such as broadband, creating a standards-based edge will likely require an ongoing structural advantage, whether via regulatory discontinuities, incumbent status, or the ability to influence customer behavior.

[222] *See* Hausman et al., *Residential Demand for Broadband*, *supra* note 190, at 133.

> Video streaming has received an immense amount of attention not only because it might compete directly with the cable TV product, but also because it embodies the qualitative leap in functionality and quantum jump in speed that broadband Internet provides.
>
> Video streaming is foreclosed as a threat to Time Warner's services. By singling out current cable TV customers for an extremely high floor price for independent ISP broadband Internet service, Time Warner is leveraging its monopoly position in cable into the broadband Internet market.
>
> Time Warner asserts complete control over video streaming by controlling the economic terms on which Quality of Service is offered.
>
> Time Warner goes on to build a wall around the video market with pricing policy that dissuades ISPs from competing for the Internet business of cable TV customers. Time Warner buttresses that wall with a marketing barrier and a service quality barrier that can further dissuade ISPs from competing for TV customers.

Northnet, An Open Access Business Model, *supra* note 193, at 6-7.

[223] Time Warner's Term Sheet and AT&T public statements about how it will negotiate commercial access after its technical trial give a clear picture of the threat to dynamic innovation on the Internet. The companies' own access policies reveal the levers of market power and network control that stand to stifle innovation on the Internet. Under the imposed conditions, the commercial space available for unaffiliated and smaller ISPs (where much innovation takes place) is sparse and ever shrinking.

[224] The AT&T preference is illustrated as follows:

> Radio GoGaGa [is] a music radio network that transmits over the Internet [and] depends on word-of-mouth and bumper stickers to attract users. . . . [Radio GoGaGa f]ounder Joe Pezzillo worries that the competitive gap could widen as broadband brings new business models.
>
> He envisions AT&T making deals with major music labels to deliver its own Internet radio, with AT&T providing the fastest connections to its partners and slower connections to sites like his. "Someone's not going to wait for our page to load when they can get a competitor's page instantly," Pezzillo said.
>
> AT&T says it has yet to formulate business models with partners, but the software the company has designed for the Boulder trial – demonstrated at its headquarters in Englewood, Colo[rado] last week – clearly includes a menu that will allow customers to link directly to its partners. Company officials acknowledge that AT&T's network already has the ability to prioritize the flow of traffic just as Pezzillo fears.
>
> "We could turn the switches in a matter of days to be able to accommodate that kind of environment," said Patrick McGrew, an AT&T manager working on the technical details of the Boulder trial.
>
> Though the Boulder trial is focused on technical issues alone, AT&T will study the way customers navigate the system as it negotiates with ISPs seeking to use its network.

Goodman, *AT&T Puts Open Access*, *supra* note 188.

[225] Thomas W. Hazlett & George Bittlingmayer, *The Political Economy of Cable "Open Access"*, (AEI-Brookings Joint Center for Regulatory Studies, Working Paper No. 01-06, 2001), *available at* http://www.aei.brookings.org/publications/working/ working_01_06.pdf., at 17 n.47 (quoting Jason Krause & Elizabeth Wasserman, *Switching Teams on Open Access?*, THE INDUSTRY STANDARD, Jan. 24, 2000, *available at* http://www.thestandard.com/article/display/1,1153,8903,00.html).

[226] *See* Hausman et al., *Residential Demand for Broadband*, *supra* note 190, at 159.

> [A] cable broadband provider will engage in conduit discrimination if the gain from additional access revenues from broadband users offsets the loss in content revenues from narrower distribution. . .
>
> To capture the gains from such discrimination, the vertically integrated cable provider must have a cable footprint in which to distribute its broadband portal service, either through direct ownership or through an arrangement to share the benefits of foreclosure with other cable providers.

[227] *See* Rubinfeld & Singer, *Open Access*, *supra* note 187, at 657.

> Hence, a cable broadband provider will engage in conduit discrimination if the gain for additional access revenues from broadband users offsets the loss in content revenues form narrower distribution. What determines whether conduit discrimination will be profitable? Simply put, if a cable broadband transport provider that controls particular content only has a small fraction of the national cable broadband transport market, then that provider would have little incentive to discriminate against rival broadband transport providers *outside of its cable footprint*. The intuition is straightforward: out-of-franchise conduit discrimination would inflict a loss on the cable provider's content division, while out-of-region cable providers would be the primary beneficiaries of harm done to non-cable competitors.

[228] Hausman et al., *Residential Demand for Broadband*, *supra* note 190, at 156 (footnote omitted). The ACA provides the calculation for cable operators:

> The major MSOs will be the clear winners in these transactions. MSOs granted exclusive distribution rights will have an opportunity to attract DBS subscribers with exclusive programming, resulting in increased subscriber revenues (a minimum of $40-$50 per subscriber) and increased system values (at least $3,500-$5,000 per subscriber)....
>
> Where do ACA members fit into these transactions? Nowhere. ACA members operate locally, not regionally or nationally. In situations involving regional or national exclusive distribution rights, there is little incentive to carve out exceptions for smaller cable systems. For each small system subscriber lost under exclusivity, the vertically integrated program provider will likely lose revenue between $0.10 and $0.75 per month, depending on the service. In contrast, for each former DBS subscriber gained through regional or national exclusive program offerings, the MSO with exclusive distribution rights will gain all monthly revenue from that subscriber, plus increased system value. In economic terms, an external cost of this gain will be the cost to small cable companies and consumers of reduced program diversity.

American Cable Association, *Comments, supra* note 194, at 13-14.

[229] Hausman et al., *Residential Demand for Broadband*, *supra* note 190, at 156 (footnote omitted).

[230] *See* Comments of the Competitive Broadband Coalition, *Implementation of the Cable Television Consumer Protection & Competition Act of 1992*, Cable Services Bureau Dkt. No. 01-290, at 10-11 (Dec. 3, 2001).

> CTCN [CT Communications Network Inc.], a registered and franchised cable operator, has been unable to purchase the affiliated HITS transport service from AT&T Broadband, the nation's largest cable operator, despite repeated attempts to do so. . . . Based on its own experience and conversations with other companies who have experienced similar problems, CTCN believes that AT&T is refusing to sell HITS to any company using DSL technology to deliver video services over existing phone lines because such companies would directly compete with AT&T's entry into the local telephone market using both its own cable systems and the cable plant of unaffiliated cable operators. AT&T simply does not want any terrestrial

based competition by other broadband networks capable of providing bundled video, voice and data services.

[231] Bernstein, *Broadband!, supra* note 192, at 12-14; Merrill Lynch, AOL *Time Warner, supra* note 192, at 33.

[232] *See* Hausman et al., *Residential Demand for Broadband*, *supra* note 190, at 149.

> It is possible that at some point in the future new technologies will emerge, or existing technologies will be refined, in such a way that they will compete effectively with cable-based Internet services. . . . [W]ithin the relevant two-year time horizon, neither DSL nor satellite-based Internet service will be able to offer close substitutes for cable-based Internet service. Hence, neither will be able to provide the price-disciplining constraint needed to protect consumer welfare.

[233] *See* Am. Online, Inc., No. C-3989, at 12 (Fed. Trade Comm'n Apr. 17, 2001), *available at* http://www.ftc.gov/os/2001/04/aoltwdo.pdf.

[234] AOL has argued:

> At every key link in the broadband distribution chain for video/voice/data services, AT&T would possess the ability and the incentive to limit consumer choice. Whether through its exclusive control of the EPG or browser that serve as consumers' interface; its integration of favored Microsoft operating systems in set-top boxes; its control of the cable broadband pipe itself; its exclusive dealing with its own proprietary cable ISPs; or the required use of its own "backbone" long distance facilities; AT&T could block or choke off consumers' ability to choose among the access, Internet services, and integrated services of their choice. Eliminating customer choice will diminish innovation, increase prices, and chill consumer demand, thereby slowing the roll-out of integrated service.

AOL, *Comments, Transfer of Control*, *supra* note 189, at 11.

[235] *See Goldman Sachs, America Online/Time Warner, supra* note 192, at 14, 17.

> AOL Time Warner is uniquely positioned against its competitors from both technology and media perspectives to make the interactive opportunity a reality. This multiplatform scale is particularly important from a pricing perspective, since it will permit the new company to offer more compelling and cost effective pricing bundles and options than its competitors. Furthermore, AOL Time Warner will benefit from a wider global footprint than its competitors. . . .[W]e believe the real value by consumers en masse will be not in the "broadband connection" per se, but rather an attractively packaged, priced, and easy-to-use service that will bundle broadband content as an integral part of the service.

[236] AOL, *Comments, Transfer of Control*, *supra* note 189.

[237] *See* Jonathan Krim, *FCC Rules Seek High-Speed Shift; Phone Firms Would Keep Cable Rights*, WASH. POST, Feb. 15, 2002, at E1 (on the higher cost of addressing problems *ex post*).

[238] AOL, *Comments, Transfer of Control*, *supra* note 189, at 9-10.

[239] *See* Merrill Lynch, AOL *Time Warner, supra* note 192, at 38: "If the technology market has a communications aspect to it, moreover, in which information must be shared [spreadsheets, instant messaging, enterprise software applications], the network effect is even more powerful." Bernstein, *Broadband!, supra* note 192, at 26: "Thus, if the MSOs can execute as they begin to deploy cable modem services in upgraded areas, they have a significant opportunity to seize many of the most attractive customers in the coming broadband land grab. These customers are important both because they represent a disproportionate share of the value and because they are bell weathers for mass-market users."

[240] Shapiro & Varian, INFORMATION RULES, *supra* note 19.

[241] *See* Hausman, et al., *Residential Demand for Broadband*, *supra* note 190, at 164. "Due to the nature of network industries in general, the early leader in any broadband Internet access may enjoy a "lock-in" of customers and content providers – that is, given the high switching costs for consumers associated with changing broadband provider (for example, the cost of a DSL modem and installation costs), an existing customer would be less sensitive to an increase in price than would a prospective customer."

[242] *See* generally Hausman, et al., *Residential Demand for Broadband*, *supra* note 190, at 136-48; Bernstein, *Broadband!*, *supra* note 192, at 8; AT&T Canada, *Comments of AT&T Canada*, *supra* note 188, at 12. "AT&T Canada notes that narrowband access facilities are not an adequate service substitute for broadband access

facilities. The low bandwidth associated with these facilities can substantially degrade the quality of service that is provided to the end customer to the point where transmission reception of services is no longer possible."

[243] Amended Complaint of the Dep't of Justice at 6, U.S. v. AT&T Corp., 2000 WL 1752108 (D.C. Cir. 2000) (No. 1:00CV01176), *available at* http://www.usdoj.gov/atr/ cases/indx4468.htm.

[244] *AT&T Canada, Comments of AT&T Canada, supra* note 188, at 12.

> The cost of switching suppliers is another important factor which is used to assess demand conditions in the relevant market. In the case of the broadband access market, the cost of switching suppliers could be significant, particularly if there is a need to adopt different technical interfaces or to purchase new terminal equipment for the home or office. Given the fact that many of the technologies involved in the provision of broadband access services are still in the early stages of development, it is unlikely that we will see customer switching seamlessly from one service provider to another in the near-term.

[245] Arora, MARKETS FOR TECHNOLOGY, *supra* note 105, at 231-232, frame this issue in terms of a trade off between "licensing revenues (the revenue effect)" and "the lower profits that the increased competition (the rent dissipation effect) from the licensee implies." Their discussion suggests the two fundamental issues that have been raised in the cable modem context are operative. The first is cable's desire to prevent high-speed Internet service from creating competitors for video services ("firms with a large market share in the product market (and by implications, possessing the required complementary assets) are better off exploiting the technology in–house"). The second is the desire to dominate the high-speed Internet market, which drives cable to undermine competition from established Internet Service Providers ("licensing is more attractive when the licensee is operating in a different market and is unlikely to be a strong competitor").

[246] Jorn Kleinert & Danial Piazolo, *Governing the Cyber Space*, in THE NEW ECONOMY AND ECONOMIC GROWTH IN EUROPE AND THE US (David B. Audretsch & Paul J.J. Welfens, eds., 2002), at 283; *see* also J. Cremer, P. Rey & J. Tirole, *Connectivity in the Commercial Internet*, 84 J. INDUS. ECON. 4 (2000).

[247] Abbate, INVENTING, *supra* note 10; Lessig, FUTURE, *supra* note 8, Chapters 3 and 4; Shane Greenstein, *Commercialization of the Internet: The Interaction of Public Policy and Private Choices, or Why Introducing the Market Worked so Well* (NBER, N.D.), *Building and Delivering the Virtual World: Commercializing Services for Internet Access* (March 31, 2000); *The Evolving Structure of Commercial Internet Markets*, in UNDERSTANDING THE DIGITAL ECONOMY (Erik Brynjolfsson & Brian Kahin, eds., 2000).

[248] Frank Matos, INFORMATION SERVICE REPORT (1988); Abbate, INVENTING, *supra* note 10.

[249] Recent ISPS counts are from BOARDWATCH MAGAZINE, *North American ISPS*. There are differences of opinion about the precise numbers. We use this source as an internally consistent set of numbers. While there are differences in details, the trends seem clear – rapid growth in the late 1990s and declines in the past couple of years.

[250] Greenstein, *Commercialization of the Internet*, *supra* note 247, emphasizes the range of services offered; "Comments of Earthlink, Inc," *In the matter of Appropriate Framework for Broadband Access to the Internet Over Wireline Facilities, Universal Service Obligations of Broadband Providers, Computer III Remand Proceedings: Bell Operating Company Provision of Enhanced Services; 1998 Biennial Regulatory Review – Review of Computer II and ONA Safeguards and Requirements*, Federal Communications Commission, CC Docket NO. 02-33, 95-20, 98-10, May 3, 2002, at 6, offers the following list: "ISPs offer a host of information functionalities under the rubric "Internet access" that includes, but is not limited to, email, web access, instant messaging ("IM"), chat rooms, content-based services (such as news, weather, music, stock quotes, etc.) web-hosting, access to software or games, and more."

[251] Berners-Lee, WEAVING THE WEB, *supra* note 18, at 80-81.

[252] Greenstein, *Building and Delivering*,, *supra* note 247, at 2.

[253] Id., at 168.

[254] Id., at 168.

[255] Id., at 168.

[256] Id., at 3.

[257] David C. Mowery & Timothy Simcoe, *The Internet*, in TECHNOLOGICAL INNOVATION AND ECONOMIC PERFORMANCE (Benn Steil, David G. Victor, & Richard R. Nelson, 2002), at 238.

[258] Allaine DeFontenay, WHY INEFFICIENT INCUMBENTS CAN PREVAIL IN THE MARKETPLACE OVER MORE EFFICIENT ENTRANTS: AN ANALYSIS OF ECONOMIES OF SCALE AND SCOPE, TRANSACTION COSTS AND THE MISUSE OF DATA (2003), at 27.

[259] Id., at 57.

[260] Id., at 39.

[261] *Northnet, An Open Access Business Model*, *supra* note 193.

[262] David Clark & Rosemary Blumenthal, *Rethinking the Design of the Internet: The End-to-End Argument vs. The Brave New World*, TELECOM. POLICY, August 10, 2000, at 24.

[263] While Earthlink pointed out that the "nondisclosure provisions have an adverse impact on the ability of the market to operate freely and on the ability of government agencies to evaluate the competitiveness of the market," it was others who actually released the agreement.

[264] AT&T has sued or threatened to sue every local jurisdiction that required open access and withheld investment in those areas. Time Warner pulled the plug on Disney and threatened to extract full subscriber value from Disney for every customer it lost when Disney offered to give satellite dishes to the public. AOL threatened to sue Prodigy for the economic harm it caused AOL when Prodigy hacked into AOL's instant messaging service.

[265] High Tech Broadband Coalition, Cable Modem Proceeding, *supra* note 55.

[266] The agreement was reached with AT&T shortly before the Comcast AT&T merger closed.

[267] *A New Model for AOL May Influence Cable's Future*, NEW YORK TIMES, August 26, 2002, at C.1; Dan Gilmore, *AOL Capitulates, Gives Up Struggle for 'Open Access'*, SAN JOSE MERCURY NEWS, September 1, 2002.

[268] Jim Hu, *AOL's Unrequited Cable Love*, CNET NEWS.COM, January 26, 2004.

[269] The Federal Communications Commission has been presented with a mountain of specific evidence of anticompetitive behavior by wire owners. Notwithstanding the grant of entry into long distance, many of these problems still afflict the provision of DSL service, as recent testimony in Texas (the second state in which an incumbent RBOC was granted entry) attest; see *Response of Onramp*, TEN QUESTIONS TO BEGIN THE COMMITTEE'S INQUIRY INTO STATE BROADBAND POLICY, Committee on State Affairs, April 3, 2002 (hereafter Onramp); *Response of Cbeyond, Inc.*, TEN QUESTIONS TO BEGIN THE COMMITTEE'S INQUIRY INTO STATE BROADBAND POLICY, Committee on State Affairs, April 3, 2002 (hereafter Cbeyond); *Response of IP Communications*, TEN QUESTIONS TO BEGIN THE COMMITTEE'S INQUIRY INTO STATE BROADBAND POLICY, Committee on State Affairs, April 3, 2002 (hereafter IP Communications); *Response of Hometown Communications*, TEN QUESTIONS TO BEGIN THE COMMITTEE'S INQUIRY INTO STATE BROADBAND POLICY, Committee on State Affairs, April 3, 2002 (hereafter Hometown); *Response of Texas CLEC Coalition*, TEN QUESTIONS TO BEGIN THE COMMITTEE'S INQUIRY INTO STATE BROADBAND POLICY, Committee on State Affairs, April 3, 2002 (hereafter TxCLEC); *Reply Comments of the California ISP Association, Inc.*, *FURTHER NOTICE OF PROPOSED RULEMAKING IN THE MATTER OF THE COMPUTER III REMAND PROCEEDINGS: BELL OPERATING COMPANY PROVISION OF ENHANCED SERVICES; 1998 BIENNIAL REGULATORY REVIEW – REVIEW OF COMPUTER II AND ONA SAFEGUARDS AND REQUIREMENTS*, Federal Communications Commission, CC Docket No. 95-20, 98-10, April 30, 2000 (hereafter CISPA); *Reply Comments of the Texas Internet Service Providers Association*, FURTHER NOTICE OF PROPOSED RULEMAKING IN THE MATTER OF THE COMPUTER III REMAND PROCEEDINGS: BELL OPERATING COMPANY PROVISION OF ENHANCED SERVICES; 1998 BIENNIAL REGULATORY REVIEW – REVIEW OF COMPUTER II AND ONA SAFEGUARDS AND REQUIREMENTS, Federal Communications Commission, CC Docket No. 95-20, 98-10, April 30, 2000 (hereafter TISPA, 2001a); *Reply Comments of the Commercial Internet Exchange Association*, *FURTHER NOTICE OF PROPOSED RULEMAKING IN THE MATTER OF THE COMPUTER III REMAND PROCEEDINGS: BELL OPERATING COMPANY PROVISION OF ENHANCED SERVICES; 1998 BIENNIAL REGULATORY REVIEW – REVIEW OF COMPUTER II AND ONA SAFEGUARDS AND REQUIREMENTS*, FEDERAL COMMUNICATIONS COMMISSION, CC DOCKET NO. 95-20, 98-10, April 30, 2000 (hereafter CIX, 2001a); *Comments of the Information Technology Association of America*, *IN THE MATTER OF REVIEW OF REGULATORY REQUIREMENTS FOR INCUMBENT LEC BROADBAND TELECOMMUNICATIONS SERVICES*, Federal Communications Commission, CC Docket No. 01-337, March 1, 2002 (hereafter ITAA, 2002); *Comments of the IP Communications Corporation*, *IN THE MATTER OF REVIEW OF REGULATORY REQUIREMENTS FOR INCUMBENT LEC BROADBAND TELECOMMUNICATIONS SERVICES*, Federal Communications Commission, CC Docket No. 01-337, March 1, 2002 (hereafter IP Communications, 2002); *Comments of the Public Service Commission of the State of*

Missouri, IN THE MATTER OF REVIEW OF REGULATORY REQUIREMENTS FOR INCUMBENT LEC BROADBAND TELECOMMUNICATIONS SERVICES, Federal Communications Commission, CC Docket No. 01-337, March 1, 2002 (hereafter MOPSC, 2002); *Joint Comments of NASUCA, et al*., IN THE MATTER OF REVIEW OF REGULATORY REQUIREMENTS FOR INCUMBENT LEC BROADBAND TELECOMMUNICATIONS SERVICES, Federal Communications Commission, CC Docket No. 01-337, March 1, 2002 (hereafter NASUCA, 2002); *Comments of Ad Hoc Telecommunications Users Committee*, IN THE MATTER OF REVIEW OF REGULATORY REQUIREMENTS FOR INCUMBENT LEC BROADBAND TELECOMMUNICATIONS SERVICES, Federal Communications Commission, CC Docket No. 01-337, March 1, 2002 (hereafter Ad Hoc, 2002); *Comments of the New Mexico Information Professionals Association of America*, IN THE MATTER OF REVIEW OF REGULATORY REQUIREMENTS FOR INCUMBENT LEC BROADBAND TELECOMMUNICATIONS SERVICES, Federal Communications Commission, CC Docket No. 01-337, March 1, 2002 (hereafter NMIPA, 2002); *Comments of Cox Communications, Inc.*, IN THE MATTER OF APPROPRIATE FRAMEWORK FOR BROADBAND ACCESS TO THE INTERNET OVER WIRELINE FACILITIES, UNIVERSAL SERVICE OBLIGATIONS OF BROADBAND PROVIDERS, COMPUTER III REMAND PROCEEDINGS: BELL OPERATING COMPANY PROVISION OF ENHANCED SERVICES; 1998 BIENNIAL REGULATORY REVIEW – REVIEW OF COMPUTER II AND ONA SAFEGUARDS AND REQUIREMENTS, Federal Communications Commission, CC Docket No. 02-33, 95-20, 98-10, May 3, 2002 (hereafter Cox, 2002); *Comments of Brand X*, IN THE MATTER OF APPROPRIATE FRAMEWORK FOR BROADBAND ACCESS TO THE INTERNET OVER WIRELINE FACILITIES, UNIVERSAL SERVICE OBLIGATIONS OF BROADBAND PROVIDERS, COMPUTER III REMAND PROCEEDINGS: BELL OPERATING COMPANY PROVISION OF ENHANCED SERVICES; 1998 BIENNIAL REGULATORY REVIEW – REVIEW OF COMPUTER II AND ONA SAFEGUARDS AND REQUIREMENTS, Federal Communications Commission, CC Docket No. 02-33, 95-20, 98-10, May 3, 2002 (hereafter BrandX, 2002); *Comments of the New Hampshire ISP Association*, IN THE MATTER OF APPROPRIATE FRAMEWORK FOR BROADBAND ACCESS TO THE INTERNET OVER WIRELINE FACILITIES, UNIVERSAL SERVICE OBLIGATIONS OF BROADBAND PROVIDERS, COMPUTER III REMAND PROCEEDINGS: BELL OPERATING COMPANY PROVISION OF ENHANCED SERVICES; 1998 BIENNIAL REGULATORY REVIEW – REVIEW OF COMPUTER II AND ONA SAFEGUARDS AND REQUIREMENTS, Federal Communications Commission, CC Docket No. 02-33, 95-20, 98-10, May 3, 2002 (hereafter NHISP, 2002); *Comments of Ruby Ranch Cooperative Association*, IN THE MATTER OF APPROPRIATE FRAMEWORK FOR BROADBAND ACCESS TO THE INTERNET OVER WIRELINE FACILITIES, UNIVERSAL SERVICE OBLIGATIONS OF BROADBAND PROVIDERS, COMPUTER III REMAND PROCEEDINGS: BELL OPERATING COMPANY PROVISION OF ENHANCED SERVICES; 1998 BIENNIAL REGULATORY REVIEW – REVIEW OF COMPUTER II AND ONA SAFEGUARDS AND REQUIREMENTS, Federal Communications Commission, CC Docket No. 02-33, 95-20, 98-10, May 3, 2002 (hereafter Ruby Ranch, 2002); *Comments of Earthlink, Inc*., IN THE MATTER OF APPROPRIATE FRAMEWORK FOR BROADBAND ACCESS TO THE INTERNET OVER WIRELINE FACILITIES, UNIVERSAL SERVICE OBLIGATIONS OF BROADBAND PROVIDERS, COMPUTER III REMAND PROCEEDINGS: BELL OPERATING COMPANY PROVISION OF ENHANCED SERVICES; 1998 BIENNIAL REGULATORY REVIEW – REVIEW OF COMPUTER II AND ONA SAFEGUARDS AND REQUIREMENTS, Federal Communications Commission, CC Docket No. 02-33, 95-20, 98-10, May 3, 2002 (hereafter Earthlink, 2002); *Comments of U.S. LEC Corp*., IN THE MATTER OF APPROPRIATE FRAMEWORK FOR BROADBAND ACCESS TO THE INTERNET OVER WIRELINE FACILITIES, UNIVERSAL SERVICE OBLIGATIONS OF BROADBAND PROVIDERS, COMPUTER III REMAND PROCEEDINGS: BELL OPERATING COMPANY PROVISION OF ENHANCED SERVICES; 1998 BIENNIAL REGULATORY REVIEW – REVIEW OF COMPUTER II AND ONA SAFEGUARDS AND REQUIREMENTS, Federal Communications Commission, CC Docket No. 02-33, 95-20, 98-10, May 3, 2002 (hereafter US LEC, 2002); *Comments of Big Planet, Inc.*, IN THE MATTER OF APPROPRIATE FRAMEWORK FOR BROADBAND ACCESS TO THE INTERNET OVER WIRELINE FACILITIES, UNIVERSAL SERVICE OBLIGATIONS OF BROADBAND PROVIDERS, COMPUTER III REMAND PROCEEDINGS: BELL OPERATING COMPANY PROVISION OF ENHANCED SERVICES; 1998 BIENNIAL REGULATORY REVIEW – REVIEW OF COMPUTER II AND ONA SAFEGUARDS AND REQUIREMENTS, Federal Communications Commission, CC Docket No. 02-33, 95-20, 98-10, May 3, 2002 (hereafter Big Planet, 2002); *Joint Comments of Cbeyond and Nuvox*, IN THE MATTER OF REVIEW OF REGULATORY REQUIREMENTS FOR INCUMBENT LEC BROADBAND TELECOMMUNICATIONS SERVICES, Federal Communications Commission, CC Docket No. 01-337, March 1, 2002 (hereafter CBeyond, 2002).

[270] Steven J. Vaughn-Nichols, *DSL Spells Trouble for Many ISPs*, SMART RESELLER, February 24, 1999.

[271] Onramp, *supra* note 269, at 16-17.

[272] ITAA, *supra* note 269, at 11; DirecTV, *supra* note 269, at 8-10.

[273] Onramp, *supra* note 269, at 5-6; NMIPA, *supra* note 269, at 5.

[274] TISPA, *supra* note 269, at 18.

[275] Indiana Regulatory Utility Commission, *Comments*, Federal Communications Commission, IN THE MATTER OF THE DEPLOYMENT OF WIRELINE SERVICES OFFERING ADVANCED TELECOMMUNICATIONS CAPABILITY, ETC., CC Docket Nos. 98-147, 98-11, 98-26, 98-32, 98-78,98-91, CCB/CPD Docket No. 98-15, RM 9244, at 14; Internet Service Providers Consortium, *Comments*, Federal Communications Commission, IN THE MATTER OF THE DEPLOYMENT OF WIRELINE SERVICES OFFERING ADVANCED TELECOMMUNICATIONS CAPABILITY, ETC., CC Docket Nos. 98-147, 98-11, 98-26, 98-32, 98-78,98-91, CCB/CPD Docket No. 98-15, RM 9244, at 14; at 7; Ad Hoc, *supra* note 115,at 26; ITAA, *supra* note 269,at 13, 15.

[276] TISPA, *supra* note 269,at 27.

[277] TISPA, *supra* note 269, at 33.

[278] Onramp, *supra* note 269, at 14.

[279] ITAA, *supra* note 269, at 10-11; CISPA, *supra* note 269, 2001a, at 27-28.

[280] TISPA, *supra* note 269, at 17.

[281] Cox, *supra* note 269, at 6.

[282] IURC, *supra* note 269, at 5; Ad Hoc, *supra* note 269, at 27; ITAA, *supra* note 269, at 16.

[283] CISPA, Reply, *supra* note 269, at 7.

[284] Onramp, *supra* note 269, at 3.

[285] TISPA, *supra* note 269, at 21; Brand X, *supra* note 269, at 2; CIX, *supra* note 269, at 8.

[286] Telephone companies achieve the margin difference by offering high volume ISPs massive volume discounts that aggregate business across state lines, without any cost justification for such a discount (see TISPA, *supra* note 269, at 37; CSIPA, *supra* note 269, at 16).

[287] Onramp, at 3, citing CFO Stephenson.

[288] Todd Spangler, *Crossing the Broadband Divide*, PC MAGAZINE, February 12, 2002 (noting pricing and service quality problems); Brian Ploskina & Dana Coffield, *Regional Bells Ringing Up Higher DSL Rates*, INTERACTIVE WEEK, February 18, 2001; Yale Braunstein, MARKET POWER AND PRICE INCREASES IN THE DSL MARKET (July 2001).

[289] Press accounts give detailed estimates of major ISPs. The number of subscribers to independent ISPs is put at 500,000 to 600,000 in a market that is in the range of 10,000,000 to 12,000,000; see Forrester.com/ER/Press/Release/0,1769,655,00.html; ISP-Planet.

[290] Greenstein, *Building and Delivering*, *supra* note 247.

[291] Patricia Fusco, *Top U.S. ISPs by Subscriber: Q1 2002*, ISP-PLANET, May 29, 2002.

[292] Techweb News, *Broadband Boom*, INFORMATION WEEK, May 12, 2004.

[293] Id., see also Scott Pruitt, *ISPs Missing the Broadband Boom*, PC WORLD, November 14, 2003.

[294] Ben Charny, **VoIP: The Broadband Bottleneck?** CNET News.com, April 7, 2004.

[295] Christopher Stern, *Cable's Closed Connections*, THE WASHINGTON POST, Oct. 11, 2003, at E1 and E2.

[296]*In the Matter of IP-Enabled Services, Notice of Proposed Rulemaking*, FCC 04-28, 19 FCC Rcd 4863 (2004) (hereafter *Notice*).

[297] Notice, at para 37.

[298] *Internet Over Cable Declaratory Ruling*, Declaratory Ruling, 17 FCC Rcd 4798 (2002); *In re Inquiry Concerning High-Speed Access to Internet Over Cable and Other Facilities*, 17 FCC Rcd 4821 (2002); *Appropriate Framework for Broadband Access to Internet Over Wireline Facilities*, CC Docket Nos. 02-33, 95-20, 98-10, Notice of Proposed Rulemaking, 17 FCC Rcd 3019 (2002), where the FCC proposes to eliminate the obligation for nondiscrimination for wireline services, as it had done for cable modem service.

[299] The definitions evolved over time as the Commission gained experience with the distinction between communications and data processing. Contrast *Regulatory and Policy Problems Presented by the Interdependence of Computer and Communication Services and Facilities*, Docket No. 16979, Final Decision and Order, 28 FCC 2d 291 (1971) and *In re* Amendment of Section 64.702 of the Commission's Rules and Regulations, *Final Decision*, 77 FCC 2d 384 (1980). (Computer II)

[300] 47 U.S.C. s 153.

[301] *Brand X v. FCC, supra* note 17, at 14764.

[302] *Federal-State Joint Board on Universal Service*, CC Docket 96-45, Report to Congress, 13 FCC Rcd 11501 (1998) (hereafter *Stevens Report)*, the *AT&T IP-Order*, and the *Pulver.com Order*, see *Revision of the Commission's Rules to Ensure Compatibility With Enhanced 911 Emergency Calling Systems, Amendment of*

Parts 2 and 25 to Implement the Global Mobile Personal Communications Satellite (GMPCS) Memorandum of Understanding and Arrangements: Petition of the National Telecommunications and Information Administration to Amend Part 25 of the Commission's Rules to Establish Emissions Limits for Mobile and Portable Earth Stations Operating in the 1610-1660 5 MHz Band, Docket Nos. CC No. 94-102, IB No. 99-67, Report and Order and Second Further Notice of Proposed Rulemaking, FCC 03-290 (Dec. 1, 2003). *Non-Accounting Safeguards of Section 271 and 272 of the Communications Act of 1934, as Amended,* Order on Reconsideration, CC Rcd 2297 (1997) and *Independent Data Communications Manufacturers Assoc. Inc.,* Memorandum Opinion and Order, Rcd 13717, 13718 (1995).

[303] *Stevens Report, at p*ara 87, 88, 89.

[304] *Petition for Declaratory Ruling That AT&T's Phone-to-Phone IP Telephony Services are Exempt from Access Charges,* WC Docket No. 02-361 (2004), Order 19 FCC Rcd 7457 (2004).

[305] *Petition for Declaratory Ruling that Pulver.com's Free World Dialup Is Neither Telecommunications nor a Telecommunications Service,* WC Docket No. 03-45, Memorandum Opinion and Order, 19 FCC Rcs 3307 (2004).

[306] *In the Matter of Vonage Holdings Corporation Petition for Declaratory Ruling Concerning an Order of the Minnesota Public Utilities Commission,* WC Docket No. 03-211 (September 22, 2003).

[307] "Comments of the Voice on the Net (Von) Coalitions," *In the Matter of IP-enabled Services,* WC Docket No. 04-36, May 28. 2004, at 3, arguing "Because of the openness of the Internet, service providers do not need to own any infrastructure to offer services. This drastically reduces barriers to entry and increases competition… Moreover, unlike the PSTN, where service providers must either build their own or rely on the incumbent's infrastructure, the Internet allows new competitors to swiftly emerge because they do not need to own or construct any infrastructure." These sentences completely confuse the code layer (Internet) and the physical layer (infrastructure). Internet Service Providers did not need infrastructure because it exists and was open. The Von Coalition seems to believe that infrastructure will continue to magically appear if they do not help to pay for it and that it will remain open, if public policy does not demand that it does.

[308] IP-Enabled Notice, para. 47.

[309] 47 U.S.C. s. 10(d).