ECONOMIC ANALYSIS AND NETWORK NEUTRALITY: SEPARATING EMPIRICAL FACTS FROM THEORETICAL FICTION

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A CRITICAL MOMENT FOR THE FUTURE OF THE INTERNET

The future of the Internet is the center of an intense debate. At the foundation of the debate is a dispute as to whether or not the firms that provide network infrastructure, the telephone and cable companies that control last-mile broadband access facilities, should be allowed to "differentiate their product." Network differentiation may be associated with last-mile broadband access providers engaging in the strategic manipulation of technology that will enable discriminatory practices that adversely affect the utilization and production of Internet content, services, and applications.

Those advocating for strategic "network differentiation," such as Vanderbilt University law professor Christopher S. Yoo, who calls it "network diversity," have gone as far as to suggest that abandonment of protocol standardization, the foundation of the Internet, could be beneficial.[1] Similarly, the Phoenix Center for Advanced Legal & Economic Public Policy Studies indicates that network neutrality principles may harm investment, if policymakers prevent last-mile broadband providers from "differentiating" their networks.[2]

This issue brief summarizes extensive reviews of these analyses,[3] showing that the benefits claimed for abandoning the principle of standardized, open communications network are small, or nonexistent, while the likely harm to consumers and the Internet economy are substantial. The Yoo and Phoenix studies reach their erroneous conclusions because they adopt narrow and biased theoretical perspectives and analytic assumptions that do not fit the economic reality of Internet-related markets.

Sound economic analysis is needed to assist policymakers in the debate over network neutrality

Economic theory can provide a useful tool to assist policymakers who are considering arguments for and against network neutrality principles. However, it is extremely important that economic theory be applied correctly. If the economic impact of abandoning network neutrality principles is selectively evaluated, economic theory can easily be abused in the policy discussion surrounding the future of the Internet.

An economic evaluation of network neutrality issues should:

- Recognize the existing benefits arising from network neutrality and open access principles which have influenced the structure and operations of the Internet. These include the demonstrated benefits of competition among Internet service providers (ISPs), and competition among providers of Internet content, services, and applications. If it is alleged that competitive harms arise from network neutrality and open access principles, these should be identified and the overall impact on competition of maintaining or abandoning network neutrality principles should be evaluated.

- Acknowledge the risks to innovation which may arise if network neutrality principles are abandoned, and broadband gatekeepers are allowed to engage in strategic differentiation

of their networks which results in discrimination against producers and users of Internet services. If it is alleged that network neutrality principles which encourage innovation at the network edge are interfering with innovation in the network core, or other innovation, this expected innovation should be evaluated in a context which considers the overall impact on innovation of maintaining or abandoning network neutrality principles.

- Recognize the important role that the standardization of network protocols has on the production and consumption of Internet content, applications, and services. The consequences of the standardization of network protocols include compatibility and interoperability, which contribute to substantial economic network effects[4] that benefit consumers and producers who use the Internet. The standardization associated with Internet protocols, by encouraging innovation and competition at the network edge, has led to tremendous product variety and consumer benefits. If it is claimed that abandoning standardization of network protocols is a preferred alternative, the alleged benefits arising from the elimination of standardization should be weighed against the consequences arising from the elimination of standardization, including the loss of compatibility, interoperability, and network effects.

- Examine the prospects for last-mile broadband competition, which is a critical assumption associated with those that advocate for the abandonment of network neutrality principles. It should be determined whether the scale economies and sunk costs associated with last-mile overbuilds, or other factors, contribute to entry barriers which make it likely that consumers will continue to face highly concentrated markets for broadband access.

- Evaluate the role that government can play when market power is associated with the provision of bottleneck inputs used by firms operating in competitive markets, such as is the case when consumers utilize last-mile broadband facilities to access the Internet and utilize myriad sources of Internet content, applications, and services.

Advocates of "network diversity" fail to consider the benefits of network neutrality, the limits of network competition and the harm of network discrimination

This report evaluates the economics of network neutrality. It also explains why recent arguments by Professor Yoo and the Phoenix Center, among others, against network neutrality, which purport to be supported by economic theory, do not reflect a reasonable application of economic theory. Thus, Professor Yoo and the Phoenix Center fail to bolster the proposition that the abandonment of network neutrality principles will generate benefits for society.

Professor Yoo argues that the most promising future direction of the Internet is one characterized by multiple, "separate but optimized" last-mile broadband access networks, which may utilize proprietary protocols, inhibit the performance of certain applications, or prevent users

from accessing some types of information. However, to reach the conclusion that such an approach is desirable, Professor Yoo ignores significant facts regarding innovation associated with an Internet governed by network neutrality and open access principles, and facts regarding the economics of Internet usage.

Likewise, it has been suggested by the Phoenix Center that network neutrality principles may contribute to the "commoditization" of last-mile broadband facilities, which will in turn discourage investment and result in harms to social welfare. These claims are entirely unsupported by economic theory or the facts associated with how innovation and economic growth have been encouraged by policies consistent with network neutrality principles.

Professor Yoo suggests that:

> The decision to permit network diversity to emerge does not ultimately depend on the conviction that it would yield a substantively better outcome, but rather from a technological humility that permits exploration to proceed until policymakers can make a clearer assessment of the costs-benefit tradeoff.[5]

However, there is ample evidence that a policy of network diversity will result in a patently inferior outcome that will favor incumbent last-mile broadband providers to the detriment of consumers and Internet innovators. The incumbent network owners currently possess market power in last-mile broadband access networks and network diversity policy will encourage the leveraging of this market power into higher levels of the Internet. Implementing a policy of network diversity will undermine the vibrant competition and rapid innovation in the provision of Internet content, applications and services, which has characterized the Internet since its privatization in 1995. Professor Yoo argues that this competition need not be protected, but, if it is not, there is no question of harm to consumers.

With regard to the exercise of market power, the Regional Bell Operating Companies (RBOCs) and the cable companies have proven themselves anything but "humble." Thus, Professor Yoo's counsel to policy makers that they should offer "humility" and deference to market forces, when those market forces are associated with market power, is bad advice. Given the dim prospects for last-mile competition, ample evidence regarding the RBOCs' and cable operators' attitudes toward competition, and the absence of any showing that abandoning network neutrality will *improve* the lot of consumers, *humility* in the face of market power is a prescription for disaster.

The Internet, based on a foundation of network neutrality and open-access principles, was perhaps the greatest innovation of the 20th century. Advocates who prescribe the replacement of open-access principles with a policy of multiple, closed networks should bear a heavy burden of proof. They have fallen far short of that mark.

THE BENEFITS OF NETWORK NEUTRALITY AND THE COST OF ABANDONING THE PRINCIPLE

Network neutrality is responsible for vibrant competition and rapid innovation

How the Internet will evolve in an environment of increasing concentration in telecommunications markets is a critical policy issue. Data processing and data communication services first emerged in an environment of structural separation, one where the providers of telecommunications services were prohibited from providing electronic data processing and data communication services (now known as "information services") on an integrated basis. In a series of landmark rulings beginning in the late 1960s, the Federal Communications Commission (FCC) determined that the provision of information services by telephone companies was best accomplished by requiring the separation of the providers of information services from the providers of telecommunications services.

It is safe to say that this separation of telecommunications and information services contributed to the foundation on which the Internet would develop. By excluding telephone companies from the integrated provision of telecommunications and information services and requiring that telephone companies provide telecommunications technologies to information service providers on a nondiscriminatory basis, the information service sector, including the Internet, was free to develop under the influence of competitive market forces, without the interference of telephone-company market power.

Furthermore, the telecommunications facilities that enabled the development of new information services, including Internet services, were provided under regulatory oversight. Access to bottleneck facilities, initially, both local and long distance, was mandated by regulators at rates which were "just and reasonable." Later, pro-competition policies pursued to encourage long-distance entry in the telephone market contributed to an abundance of competitively provided long-distance transmission capacity, which was quickly put to use as the Internet expanded during the early privatization period of the mid-1990s. Long distance competition and consumer choice was made possible and continues to depend on a form of network neutrality – an obligation on local telephone companies to provide "equal access" for competing long distance service providers.

Dial-up Internet access, the first mass-market means of accessing the Internet, provided neutral transmission capacity which encouraged vibrant competition in the ISP market. Consumers could pick and choose among ISPs which best served their needs, the telephone company did not have the ability to interfere with consumer choice. Additionally, unmetered flat rates for Internet access were encouraged due to the fact that regulators had favored flat-rate local service, further boosting the popularity of the new Internet services. Thousands of ISPs, accessed by consumers through local flat rate calling, adapted the technical capabilities of the Internet for mass market consumers and offered an array of services that drove adoption.[6]

Open and standardized network protocols fueled Internet innovation

The Internet opened new dimensions for human interaction, and provided new engines of economic growth. At the foundation of the technology that has enabled these developments is a novel philosophy of communication network design. Prior to the emergence of the Internet, communication networks were designed and operated by telephone companies. The telephone network, operating under the control of AT&T and other telephone monopolies, was designed to place computer intelligence "inside" the network, out of the reach of end-users. The telephone network was operated in a manner that limited the end-user's ability to attach innovative devices to the network, or otherwise take advantage of network technology in ways not designed (and sold) by the telephone company. The telephone company was the seller of network services, and end-users were the buyers of network services—end of story.

The Internet turned the telephone-company model "inside out." Any device that abided by the standardized and open Internet protocols could be attached to the network, and any innovator who utilized these publicly available Internet protocols could develop new content, applications, and services which would be provided over the Internet. Devices (mainly computers) attached to the edge of the network thus became the most important component of the Internet. The computers at the "network edge" could either supply network applications, content, or services, or could be used to consume network applications, content, or services. Further innovations led to the blending of computer functions at the network edge, such as those associated with file sharing technologies, where those at the network edge simultaneously produce and consume Internet content and applications.

The foundation of the innovations which are associated with the Internet—e-mail, web browsing, search engines, online auctions, e-commerce, streaming media, file sharing—are open and standardized network protocols. No firm has the ability to act as a gatekeeper associated with access to the protocols, and thus determine which applications, content, or services should be allowed to use the Internet. Innovation associated with the Internet has been fueled by the high level of deference to the network edge, and the equal opportunity to utilize network resources enabled by Internet protocols and pro-competitive policies.

In the early development of the Internet, those involved were determined that the network not "step on the toes" of the developers of the technologies which would ultimately use the network.[7] Those that designed the initial Internet protocols could not anticipate what direction future innovation might take. As a result of this insight, open and neutral protocols underlie how the Internet operates today.[8] The greatest potential for innovation associated with the development of new network applications occurs when the underlying network does not introduce artificial or arbitrary constraints on how those at the network edge innovate.

UNGROUNDED, SELECTIVE THEORY CAN MISLEAD POLICYMAKERS

The potential downside of differentiated last-mile broadband networks must be evaluated

Those advancing economic arguments directed at the alleged harms arising from network neutrality fail to address the impact of the transformation from an "open access, network neutrality" world, to one where the owner of the last-mile access pipe dictate how end-users may utilize network resources. The costs and benefits of "network differentiation" or "network diversity" must be thoroughly evaluated, and economists have extensively studied the pros and cons of sellers differentiating their products. While the Phoenix Center now points to only benefits associated with network differentiation, it is notable that in another Phoenix Center paper published in July of 2005, a clear recognition of the importance of evaluating the *benefits and costs* of product differentiation is presented, and the Phoenix Center identified in 2005 issues with product differentiation which they now ignore completely:

> As to whether consumers are better off as a result of product differentiation, the answer is "it depends." Consumers usually value variety, *so while differentiation results in higher prices, the value of increased variety may offset the reduction in consumer welfare from higher prices.* So, there is a trade-off for consumers between variety and price. Differentiation is not always beneficial to consumers, and some firms may excessively differentiate in an effort to more aggressively soften price competition. *One type of differentiation that would harm consumers is differentiation through sabotage, where one firm reduces the quality of a rival's product instead of improving its own quality.* Product differentiation may also create entry barriers by forcing entry to incur increased sunk advertising costs to win customers.[9]

Consumers may not benefit from network differentiation. Furthermore, firms may have the ability to differentiate their product by degrading the quality of a rival's product, an all too real prospect when considering the need for network neutrality policy.

Professor Yoo and the Phoenix Center's evaluations of network differentiation present an overly simplified and unrealistic view of how a policy that abandoned network neutrality would affect consumers and firms. They completely ignore the impact of the abandonment of network neutrality on current competition in markets for, and the availability of, Internet content, services, and applications of consumers' choosing. Both Professor Yoo and the Phoenix Center ignore negative impacts on the ability of individuals and firms operating at the network edge to innovate and invest. This downside of network differentiation in last-mile broadband facilities will have a significant and negative impact on social welfare. Furthermore, the very real possibility that the operators of last-mile broadband access facilities would differentiate their product by sabotaging access to Internet content, applications, and services of the user's choice is a tremendous

oversight in both the Yoo and the Phoenix Center's analysis of the impact of network differentiation.

Evaluation of alternatives to network neutrality must include the negative impact of change on competition and innovation

This possibility is more than hypothetical. For example, in 2005 Vonage, a provider of Internet telephone service over broadband access facilities, complained to the FCC that Madison River Telephone Company had blocked ports used for VoIP applications, effectively disabling consumers' ability to utilize VoIP. On March 3, 2005, the FCC approved a settlement agreement in which Madison River agreed to pay the U.S. Treasury a fine of $15,000, and to no longer block VoIP ports.[10] Sabotaging non-cooperative competitors by excluding them from the "fast lane," or extorting rents, while favored affiliates and partners are given advantages, are consequences which must be anticipated from telephone and cable companies who demand the right to discriminate and exclude. The "separate but optimized" world that Professor Yoo invents to claim a benefit for network diversity would require blocking, impairment, or discrimination to achieve the separation that he argues will be beneficial.

If deference to the network edge is abandoned due to the attack on network neutrality principles, then innovation will undoubtedly be affected. If innovation is slowed or prevented due to the abandonment of network neutrality principles, then significant harm to consumers and firms will result. Some providers of Internet access have begun to interfere with what happens at the network edge. Insights into the consequences of non-neutral network management policies are exemplified by the terms of service associated with a Verizon 3G wireless Internet access plan:

> **Unlimited NationalAccess/BroadbandAccess:**
>
> Subject to VZAccess Acceptable Use Policy, available on www.verizonwireless.com. NationalAccess and BroadbandAccess data sessions may be used with wireless devices for the following purposes: (i) Internet browsing; (ii) email; and (iii) intranet access (including access to corporate intranets, email and individual productivity applications like customer relationship management, sales force and field service automation). *Unlimited NationalAccess/ BroadbandAccess services cannot be used (1) for uploading, downloading or streaming of movies, music or games, (2) with server devices or with host computer applications, including, but not limited to, Web camera posts or broadcasts, automatic data feeds, Voice over IP (VoIP), automated machine-to-machine connections, or peer-to-peer (P2P) file sharing, or (3) as a substitute or backup for private lines or dedicated data connections.* NationalAccess/ BroadbandAccess is for individual use only and is not for resale. We reserve right to limit throughput or amount of data transferred, deny or terminate service, without notice, to anyone we believe is using NationalAccess or BroadbandAccess in any manner prohibited above or whose usage adversely impacts our network or

service levels. Verizon Wireless reserves the right to protect its network from harm, which may impact legitimate data flows.[11]

The fact that Verizon's 3G wireless broadband service has usage restrictions associated with uploading, streaming, VoIP, or peer-to-peer will hinder innovation in these areas. If these types of restrictions were placed more broadly on network users, due to the rise of "differentiated" last-mile networks, the impact on innovation would be pronounced. If, for example, end-users have limited upload capabilities or cannot use a service for streaming, then the incentive and ability to innovate in these areas is greatly reduced. Similar restrictions have been introduced on an intermittent basis whenever the principle of network neutrality has been relaxed.[12] The threat that network operators may introduce such restrictions on an intermittent basis also pollutes the open environment for innovation on the Internet.

Vertical integration grounded on facility-based market power has potentially significant anticompetitive and anti-consumer effects

One likely consequence of the abandonment of network neutrality principles would be increased "vertical integration." With vertical integration the owners of last-mile broadband facilities could acquire providers of Internet content, services, and applications, and sell consumers bundles of e-mail services, search engine capability, and e-commerce—similar to the bundling strategies pursued by telephone and cable companies with voice and video services that they currently offer. Such a transformation would rob consumers of their ability to choose, and diminish the benefits of competition which are currently available to users of Internet content, services, and applications.

Professor Yoo argues that such vertical integration is beneficial, however, his interpretation of vertical integration rests solely on the "Chicago School" of economics' teachings regarding the desirability of vertical integration. Professor Yoo overlooks other economic interpretations of vertical integration, including the extensive literature associated with post-Chicago analysis of vertical relationships.[13] This alternative literature rejects the simplified structure of the Chicago School's approach to vertical relationships and utilizes the tools of modern industrial organization theory to analyze market structures, which are more complex (and realistic) than the approach taken by the Chicago School.[14] Professor Yoo's myopic approach to the evaluation of vertical integration can only lead to incorrect advice regarding the appropriateness of network neutrality principles.

Providers of last-mile broadband facilities who possess market power will be unlikely to increase bandwidth in response to increased end-user or third-party content providers demand for bandwidth. Rather, the natural and more profitable way to "manage" end-user or third-party providers will be to raise prices for, or otherwise limit the ability to utilize, the bandwidth needed for the successful delivery of content and applications.[15] The ability to charge an end-user or a third-party provider each time they activate an application that *competes* with offerings similar to those provided by the last-mile broadband provider (e.g. video, gaming and voice) indicated that the biggest "innovation" resulting from the policy of network diversity will be higher prices for those who use Internet applications that provide an alternative to the broadband provider's

offerings. These higher prices for use of Internet content, services, and applications will act as a tax on consumption of services provided by third-party sources. This effective taxation will undermine innovation and incentives to invest at the network edge.

DIM PROSPECTS FOR VIGOROUS COMPETITION BETWEEN FACILITIES

Critics of network neutrality downplay entry barriers in last-mile broadband networks

The Phoenix Center's analysis, based on a mathematical economic model, builds from a foundation disconnected from the reality of scale economies and substantial sunk costs of network construction. The Phoenix Center's approach also excludes any evaluation of the economic impact of eliminating network neutrality on current competition for the provision of Internet services, content, and applications, or any evaluation of innovation at the network edge.

Most consumers in the U.S. face a highly concentrated market for broadband services. A recent analysis published by the Government Accountability Office (GAO) finds a duopoly broadband market, with the supply of residential broadband access coming almost exclusively from telephone company DSL and cable company Cable Modem service.[16] Similarly, the Federal Communication Commission's most recent statistics regarding broadband deployment also show the vast majority of all broadband subscribers either using either DSL or Cable Modem service.[17] As last-mile broadband competition does not exist, there must be some factors contributing to this outcome, and economists typically evaluate *entry barriers* when examining why a market displays scant evidence of competitive entry.

When considering entry barriers which contribute to the highly concentrated markets for broadband services which are a reality for consumers, it immediately becomes clear that the substantial fixed and sunk costs of building last-mile networks discourage entry. Communication networks also experience economies of scale and density, which also contribute to entry barriers. The unit costs of building a network are lower the closer consumers are in proximity to one another, and lower the more consumers that are present in a given area. Likewise, geographic characteristics, such as terrain, soil conditions, and weather extremes will impact the costs of constructing a network, and may contribute to entry barriers.

Thus, high-density downtown urban areas are more likely to see more than one or two providers of last-mile broadband facilities. Consumers residing in suburban or rural areas are much less likely to have choices among broadband providers, and in rural areas, to have broadband service at all.[18] However, even in high-density urban areas, residential consumer choice may be limited due to the fact that entrants in the broadband market frequently specialize in serving business firms, or due to multi-tenant building landlords who enter into exclusive

agreements with a single broadband provider, typically the incumbent telephone or cable television company.

Both Professor Yoo and the Phoenix Center fail to adequately address entry barriers, such as economies of scale, and the prospects for last-mile broadband competition. The Phoenix Center simply ignores the presence of scale economies in last-mile broadband access networks. They rely on a technical economic model that assumes that there are no cost advantages associated with firm size. In other words the unit cost of production for an incumbent monopoly firm producing all output is exactly the same as the unit cost for each firm when competition is introduced.[19] This is a highly unrealistic assumption.

Professor Yoo, in contrast, acknowledges that scale economies exist, but he fails to provide a reasonable explanation of how the entry barrier arising from scale economies might be overcome. He opines that differentiated networks could overcome their cost disadvantage by charging higher prices for their differentiated services because consumers will place a higher value these services, which will be provided over "separate but optimized networks."[20] He cautions, however, that we should not expect the market power of the dominant networks to disappear quickly and attaches no significance to the fact that the exercise of market power burdens consumers with overcharges and stifles innovation.[21] He offers no predictions about when or if competition will be sufficient to end the abuse of market power, only the theoretical principle that we should prefer to solve these problems with competition policy.

Moreover, Professor Yoo fails to consider the net impact of his "separate but optimized" networks on consumer choice. Consumers will evaluate the overall impact of an alternative "optimized network," which in Professor Yoo's view will provide differentiated and non-standardized services. Any gains in consumer satisfaction from the non-standardized services will be weighed by consumers against the higher price for the service, and the losses in consumer satisfaction resulting from the degradation in interoperability and loss of network effects, which result from selecting a non-standardized alternative network. Consumer recognition of the downside of non-standardized network services undermines the market feasibility of the non-standardized services.

Sunk costs make last-mile broadband competition less likely

Economists have devoted considerable energy to understanding the important role that sunk costs play in shaping market behavior and outcomes. Sunk costs play a critical role in influencing broadband market outcomes. However, the importance of sunk costs is downplayed by the Phoenix Center and Professor Yoo. When last-mile broadband facilities are constructed, a firm necessarily incurs significant sunk costs. Sunk costs are not recoverable once they are made. For example, when fiber optic cable is deployed, all of the substantial costs of installing those cables (digging trenches, tearing up streets, running conduit, stringing wires on poles) are sunk. The value of the network, should the business venture fail, will be a fraction of the installed price, with the difference between the depreciated value of the assets and the market value (which may be zero) reflecting the sunk costs.[22] Unlike other firms which face large investment costs, such as an airline which may resell its aircraft should a particular route prove to be unprofitable,

broadband network providers who are forced to dispose of their assets are only able to recover a fraction of their investment once it is made (and that fraction may be close to zero). The need to incur sunk costs increases the risk for any entrant considering building its own facilities, and thus makes those investments less likely.

Importantly, however, economists also recognize that sunk costs, if incurred by an incumbent firm, increase the likelihood that any new entrant will face a vigorous pricing response by the incumbent. Economic theory tells us that firms who have already incurred sunk costs should disregard these costs for competitive pricing purposes. In other words, incumbents who have incurred sunk costs, if pressured by new entrants, should be expected to drop prices to very low levels—levels that do not contribute to the recovery of the incumbent's sunk costs until the entrant is repelled. Such a prospect further discourages entrants. New market entrants must take a forward-looking view of sunk costs, and will not be able to justify incurring sunk costs if the expected pricing response of the incumbent results in market prices which prevent the recovery of the sunk costs that the entrant will need to incur. Both Professor Yoo and the Phoenix Center downplay the impact of sunk costs on the potential for competition to emerge in last-mile broadband facilities, and this oversight undermines the credibility of their analyses and recommendations.

This blind spot is most remarkable in the case of the Phoenix Center, which spent the better part of a decade arguing that the market would support, at best, a very small number of competing facilities. Less then a year ago, Phoenix affirmed this finding.

> As consistently demonstrated by academic and Phoenix Center research, and again in this POLICY PAPER, given the *huge fixed and sunk costs* inherent to the construction and commercial operation of communications networks, the equilibrium level of concentration of terrestrial firms in local communications markets (voice, video, and data) will be relatively high… *fewness arises because scale economies and sunk costs limit the number of firms that can profitably serve a market – and local communications networks are notoriously riddled with scale economies and sunk costs.* Any policymaker interested in local communications markets should, therefore, start from the assumption that there will, at best, be only a "few" facilities-based firms.[23]

A REALITY CHECK

History shows a poor track record for last-mile facilities-based competition

While alternative broadband access technologies exist, data shows that they have only established a trivial presence in the marketplace—the prospects for robust competition in last-mile broadband access markets are slim. Professor Yoo and the Phoenix Center ignore this historical evidence when developing their arguments that assume that robust last-mile broadband competition is likely.

Lessons learned in other telecommunications markets lead to the conclusion that there has been little luck in sustaining competition for last-mile facilities. For example, following the implementation of the Telecommunications Act of 1996, which eliminated legal entry barriers in the local exchange market, competitive local exchange carriers (CLECs) emerged and began to construct new last mile-facilities, primarily in the core business districts of urban areas, targeting large business customers.[24] These independent alternative last-mile facilities have not proved durable. For example, two of the largest facilities-based CLECs, Teleport and MFS, were acquired by other, larger, CLECs (AT&T and MCI)[25] in the late 1990s.[26] AT&T and MCI expanded their facilities and competed for a time against incumbent local exchange carriers using these last-mile assets, however, this facilities-based last-mile competition was not sustainable. Now the assets of the formerly independent CLECs AT&T and MCI have been acquired by the incumbent carriers SBC (which now operates using the "at&t" name) and Verizon. Very few facilities-based CLECs survive today. Thus, the last-mile competition that was envisioned under the Telecommunications Act has not proved to be enduring.

Similarly, with regard to wireless telephony, initial arrangements provided two cellular licenses in each market area, with the incumbent telephone company given the right of first refusal for one of the licenses, an arrangement which frequently resulted in the cellular carrier affiliated with the incumbent "competing" against an independent wireless provider. Of course, the "competition" under the cellular duopoly arrangements resulted in high prices and poor service quality, and low take-rates for the service. Spectrum reallocation and the new policy of FCC auctions resulted in increased wireless competition, with numerous licenses becoming available in any specific market area. This last-mile voice wireless competition is also proving to be less than durable. Due to the FCC's elimination of restrictions on the amount of spectrum that can be controlled by a firm in a specific market area, major mergers of wireless firms have occurred. AT&T (the long distance provider and CLEC) spun off its wireless operations in 2001. AT&T wireless was then acquired by Cingular Wireless (jointly owned by the SBC and BellSouth, [who are now also merging]) in 2004. Voicestream wireless merged with Omnipoint Communications and Aerial Communications in 2000. Voicestream was later acquired by Deutsche Telecom and now operates under the T-Mobile name. In 2005 Sprint combined its wireless operations with the wireless operations of Nextel. Also in 2005, Western Wireless was acquired by the wireless and local exchange operator Alltel. Based on the evaluation of wireless markets in 2006, some industry observers indicate that the wireless market may still be "too crowded," and point to the likelihood of further consolidation.[27] The consolidation in the wireless industry points to an emerging oligopoly market in wireless, with the two largest wireless firms (Cingular and Verizon Wireless) being owned by two of the three remaining RBOCs. Thus, last-mile consolidation is evident in the wireless segment as well.

Fiber deployment by incumbents will make additional broadband overbuilds less likely

Fiber optic cable deployment by incumbent telephone and cable companies will have a significant impact on the prospects for last-mile broadband competition. Once a customer is served by fiber cable, all non-mobile communications services could be provided over the single

fiber pathway: voice, super-high-speed data, and HDTV quality video. Once fiber is put in place by one provider, the business case for additional high-speed last-mile facilities weakens. This fact is readily discernable by efforts of incumbents to block fiber-to-the-home projects that have been pursued by municipalities. Both incumbent telephone companies and incumbent cable operators have taken steps to disable the attempts of municipalities to deploy fiber.[28] Thus, fiber optic cable, either connected directly to the household, or terminated near the home (and using existing metallic cable distribution to bridge the last few hundred feet), will provide a virtually unlimited supply of bandwidth to any end-user. Once fiber is deployed, its vast capacity will undermine the attractiveness of other technologies which are not capable of delivering the extremely high bandwidth (e.g., 100 Mbps) which fiber is capable of delivering to end users. However, these facts are not weighed in the analyses offered by the Phoenix Center and Professor Yoo.

It is simply not reasonable to believe that capital markets will support numerous last-mile overbuilds, using fiber optics, wireless, or broadband over power line technology, especially if incumbent telephone company and cable companies are well on their way to deploying fiber to, or close to, the home. Alternative technologies have deployment or operational problems. For example, broadband over power line (BPL) technology, which has the potential to share existing electric company power distribution networks is currently in the trial phase, but problems have emerged with this technology, especially due to its generation of external interference which affects radio transmission of both public safety agencies and ham radio operators. The generation of radio interference has been an unresolved issue in several BPL trials, and led to the termination of at least one trial.[29] BPL may offer some promise as an alternative last-mile facility if the interference problems can be overcome. However, expected transmission speeds from BPL (2Mbps to 6Mbps) are much lower than those available from fiber optics.[30] Furthermore, BPL will face a market where incumbents have already gained first-mover advantage by deploying fiber. As was recently noted by one analyst: “By the time it (BPL) really arrives in the market, terrestrial broadband will be almost fully saturated.”[31]

Fixed wireless services, such as WiMax service, may be deployed with lower levels of investment and sunk costs than fiber, but suffer from other limitations, including the requirement that high-frequency radio waves be utilized to provide the service. Higher frequency radio waves are more likely to require a direct line of sight between points of transmission.[32] Constructing line-of-sight wireless networks may be useful for network transport, but it is much more costly to install as a last-mile facility. The very high frequencies in which WiMax operates, ranging between 2GHz and 11GHz for the non-line-of-sight service, and up to 66GHz for the highest-speed line-of-sight transmission, indicates that the spectrum is not optimal for last-mile facilities. Finally, it is also notable that due to the pending merger of at&t and BellSouth, the resulting company will control a significant number of WiMax licenses.[33] Regulators may require the divestiture of these licenses as a merger condition, however, if they do not, it is difficult to imagine that the licenses will be used by the merged company to compete against its fiber-based broadband offering.

Network neutrality and differentiated last-mile networks are not incompatible

Critics of network neutrality argue that a harm arising from such a policy is the loss of differentiation in last-mile networks. It is argued that consumers will benefit from product differentiation in last-mile networks, and that policies which favor network neutrality will rob consumers of this potential benefit. This criticism of network neutrality is based on specious foundations. As discussed above, Cable Modem and DSL dominate the market for last-mile broadband. These broadband networks have inherent differences related to the technologies on which they are based. Consumers can also take advantage of last-mile differentiation related to the amount of bandwidth which consumers may purchase—higher download speeds improve application performance. But this differentiation is consistent with network neutrality.

While Professor Yoo and the Phoenix Center point to the alleged expansion of consumer benefits associated with further network differentiation, both fail to consider the impact of network differentiation on the expansive differentiation of Internet applications, content, and services which are provided on a competitive basis. Abandonment of network neutrality principles and the ability of last-mile broadband gatekeepers to discriminate have the potential to undermine existing product differentiation. Consumers today face extensive product variety associated with their use of the Internet. For example, consumers typically receive e-mail services from their ISP. However, numerous other e-mail providers offer services, some for free and some for a charge, which allows the consumer to select the e-mail offering which best suits their needs. Similarly, consumers are presented with differentiation among e-commerce providers, which allows consumers to benefit from market leaders, such as Amazon.com, and niche market providers who may offer specialty services better suited to the needs of some customers. Professor Yoo and the Phoenix Center fail to address the likely downside of the abandonment of network neutrality principles—reduced competition and product variety for Internet content, applications, and services. As a result they provide an incomplete evaluation of how their policy proposals would impact consumers.

Network differentiation has already been proved inferior to standardization and network neutrality

It is notable that network differentiation has already been tried by consumers in the narrow-band dial-up world, and consumers overwhelmingly rejected that approach to the provision of electronic information and communication services once the open-access Internet, built on a foundation of policies that promoted network neutrality, became available. At one time firms like America Online, GEnie, Delphi, Prodigy, and Compuserve offered consumers proprietary data processing and data communication services over incompatible and non-interconnected networks. This approach to selling data services ultimately faded as the public Internet became available. Most of the firms that pursued the network differentiation business model no longer exist, and those that do survive have combined Internet access with their proprietary offerings.

Consumers have already voted with their feet away from the proprietary data network model, once given the opportunity to consume electronic data and communication services in an open-access environment. The reason for this exhibited consumer sentiment is the same in the broadband world as it was in the dial-up world—consumers place a high value on services based on policies which encourage protocol standardization, interoperability, and network effects. It is only now, because of telecommunications policy reversals that enable the owners of last-mile broadband facilities to leverage market power in last-mile broadband markets, that the inferior market offering of restricted access to Internet services could be forced on the consuming public.

Standardization and network neutrality have repeatedly proved superior

The disregard for the history of communication networks in Professor Yoo's paper is rampant. Standardization and network neutrality have been the basis for competitive success in a wide range of services built on top of the last mile platform in addition to the Internet.

- As noted earlier, long distance competition rests on a form of network neutrality – "equal access."[34]
- To the extent that wireless competition exists, it was founded on the obligation of nondiscriminatory interconnection and carriage.
- The independent phone companies that emerged after the AT&T patents expired did not, for the most part, compete head-to-head with the incumbent, they gravitated to areas that had not been served and when AT&T refused to interconnect with them and carry their traffic, state and federal governments stepped in to require interconnection.
- The success of Direct Broadcast Satellite (DBS), which Professor Yoo attributes to an exclusive deal with the NFL for a sports package, ignores the fact that DBS actually began to thrive many years earlier, when Congress ordered cable operators to give satellite providers nondiscriminatory access to their programming through the 1992 Cable Consumer Protection Act.[35]
- The long history of successful, mandated interoperability and interconnection also lays to rest another claim that is frequently made in the effort to press policymakers to abandon network neutrality – the claim that imposing an obligation of non-discrimination on communication networks constitutes an unconstitutional taking of private property. The courts have rejected this argument repeatedly and much stronger principles of non-discrimination have been part and parcel of the transportation and communication networks of America since its founding.

These lapses of historical memory might be excusable, if the network operators themselves had not recently reminded us of their importance. In March of this year, Time Warner, a cable operator seeking to provide telephone service, petitioned the FCC to require local telephone companies to give stop blocking their telephone traffic.[36] In the same month, Verizon,

a telephone company seeking to provide video service, filed a complaint at the Federal Communications Commission, demanding that cable operators give them access to programming under the 1992 Cable Act.[37] Network operators understand the power of discrimination and exclusion in network access.[38] At the Senate hearing on Competition and Convergence, each industry vigorously defended their demands for nondiscrimination when it came to telephone interconnection and cable programming, but they agreed that Internet service providers and applications developers should not be afforded the same protections.

CONCLUSION: NETWORK NEUTRALITY HAS BEEN HIGHLY SUCCESSFUL AND SHOULD NOT BE ABANDONED

Policy makers can benefit from the application of economic theory to the problems raised by the prospects of the abandonment of network neutrality principles. However, care should be exercised to ensure that economic theory is correctly applied, and that economic analysis is complete. The guidance offered by Professor Yoo and the Phoenix Center fails to satisfy the prerequisites of meaningful economic analysis of network neutrality and, as a result, they offer policymakers flawed advice regarding the future of the Internet.

The Internet succeeded not because the Federal Communications Commission could not regulate interconnection and carriage of communications networks, as Professor Yoo claims, but because it did so under the Computer Inquiries. The actual history is that by refusing to allow the telephone companies to discriminate, the FCC created a key part of the environment for the Internet to flourish.

Professor Yoo and the Phoenix Center's papers get the policy problem exactly backwards. They say we should not risk imposing network neutrality for fear of stifling competition and innovation in facilities. In truth, it was network neutrality that gave us the vibrant competition and innovation on the Internet that we have enjoyed for a quarter of a century. The public policy question is, "should we abandon network neutrality and risk destroying the Internet?" Since network neutrality has succeeded so dramatically, critics must show very tangible benefits from changing that policy; these analyses do not even come close to meeting that burden.

ENDNOTES

[1] Christopher Yoo, "Promoting Broadband Through Network Diversity." February 6, 2006. Available at: http://law.vanderbilt.edu/faculty/Yoo%20-%20Network%20Diversity%202-6-06.pdf
Professor Yoo's study was funded by the National Cable and Telecommunications Association (the principal trade association of the cable television industry in the United States). See, "Law and Technology Professor Releases Study on Net Neutrality," TMCNet News, February 6, 2006. http://www.tmcnet.com/usubmit/2006/02/06/1346622.htm

[2] George S. Ford, Thomas M. Koutsky and Lawrence J. Spiwak, "Network Neutrality and Industry Structure," Phoenix Center for Advanced Legal and Public Policy Studies, Policy White Paper No. 24, April 2006. Available at: http://www.phoenix-center.org/ppapers.html

[3] Trevor R. Roycroft, "Network Neutrality, Product Differentiation, and Social Welfare. *A Response to Phoenix Center Policy Paper No. 24*." Roycroft Consulting Policy White Paper. May 3, 2006. Available at:
http://www.roycroftconsulting.org/response_to_Ford.pdf
Trevor R. Roycroft, "Network Diversity—A Misguided Policy. A Response to Christopher S. Yoo's 'Promoting Broadband Through Network Diversity'." Roycroft Consulting Policy White Paper. March 1, 2006. Available at: http://www.roycroftconsulting.org/response_to_Yoo.pdf

[4] Economic network effects are present when the value of a good or service increases as the number of individuals using the good or service increases. For example, prior to the mid-1990s, private e-mail systems were not connected to the Internet, but allowed electronic communication among a relatively small group of users. Once the Internet was privatized, private e-mail systems could connect to the Internet, which greatly expanded the number of individuals who could be reached by e-mail. The ability to send an e-mail message to anyone with an Internet connection increased the value of e-mail, thus exhibiting network effects.

[5] Yoo, p. 7.

[6] Shane Greenstein, *Building and Developing the Virtual World: Commercializing Service for Internet Access* (March 31, 2000); Tim Berners-Lee, *Weaving the Web: The Original Design and Ultimate Destiny of the World Wide Webby Its Inventor* (1999) pp. 80-81.

[7] Interview with Stephen Crocker, p. 20. Charles Babbage Institute Oral Histories. http://www.cbi.umn.edu/oh/display.phtml?id=150

[8] Robert E. Kahn and Vinton G. Cerf, "What is the Internet," in Mark Cooper (Ed.), *Open Architecture as Communications Policy* (Stanford: Center for Internet and Society, 2004).

[9] George S. Ford, Thomas M. Koutsky and Lawrence J. Spiwak, "Competition After Unbundling: Entry, Industry Structure and Convergence," Phoenix Center Policy Paper Number 21, July 2005, emphasis added, p. 24, emphasis added. Available at: http://www.phoenix-center.org/ppapers.html

[10] See: *In the Matter of Madison River Communications, LLC and affiliated companies*, File No. EB-05-IH-0110 Acct. No. 200532080126 FRN: 0004334082, DA 05-543. Order issued March 3, 2005.

[11] Verizon Wireless terms of service: http://www.verizonwireless.com/b2c/promotion/controller?promotionType=miniPac&action=miniStart

[12] Tim Wu, "Network Neutrality, Broadband Discrimination," "Broadband Policy, A Users Guide," in Mark Cooper (Ed.), *Open Architecture as Communications Policy*.

[13] See, for example, Michael Riordan and Steven Salop, "Evaluating Vertical Mergers: A Post-Chicago Approach," *Antitrust Law Journal, Vol. 63,* 1995; Oliver Hart and Jean Tirole, "Vertical Integration and Market Foreclosure," *Brookings Papers on Economic Activity*, 205, 1990; Martin K. Perry, "Vertical Integration: Determinants and Effects," in *Handbook of Industrial Organization,* (Richard Schamlensee and Robert Willig eds.) 1989; Jean Tirole, *The Theory of Industrial Organization*, Chapter 4, MIT Press, 1989.

[14] David S. Evans and Michael Salinger. "Competition Thinking at the European Commission: Lessons from the Aborted GE/Honeywell Merger," George Mason Law Review, Vol. 10, Spring 2002, p. 512.

[15] "Cisco Service Control: A Guide to Sustained Broadband Profitability," Cisco Systems White Paper, p. 6 While this white paper was accessed by the author on February 16, 2005 on the Cisco website, it has since been removed. It is available at: http://www.democraticmedia.org/PDFs/CiscoBroadbandProfit.pdf

[16] "Broadband Deployment is Extensive throughout the United States, but It is Difficult to Assess the Extent of Deployment Gaps in Rural Areas," GAO, May 2006, p. 12.

[17] High-Speed Services for Internet Access: Status as of June 30, 2005. Industry Analysis and Technology Division, Wireline Competition Bureau, April 2006.

[18] The GAO report found that while "it is clear that the deployment of broadband networks is extensive, the data may not provide a highly accurate depiction of local deployment of broadband infrastructures for residential service, especially in rural areas." GAO, *op. cit.*

[19] The cost structure assumed in the Phoenix Center paper results in the same unit costs for the firms in question under the cases of monopoly and duopoly, as shown in their equations (7), (17), and (25).

[20] Christopher Yoo, "Promoting Broadband Through Network Diversity," *op cit.*, p. 24.

[21]Yoo, p. 27.

[22] Motorola's Iridium satellite telephone system provides a real-world example of sunk costs. Motorola constructed its system by investing over $5 billion. Market demand did not materialize, Iridium fell into bankruptcy, and the assets were eventually sold for $25 million. The non-recoverable "sunk" costs thus approached 99.5 cents for every dollar invested. See: http://www.forbes.com/2001/11/30/1130tentech.html

[23] George S. Ford, Thomas M. Koutsky and Lawrence J. Spiwak, "Competition After Undundling: Entry, Industry Structure and Convergence," Phoenix Center Policy Paper Number 21, July 25, 2005, emphasis assed. Available at: http://www.phoenix-center.org/papers.html.

[24] See, for example, Richard G. Tomlinson, *Tele-Revolution*, Penobscot Press, 2000, Chapter 10.

[25] MFS was acquired by WorldCom, which later acquired MCI and began operating under the MCI brand name.

[26] "AT&T, SBC To Buy Carriers," *Information Week*, January 12, 1998. http://www.informationweek.com/664/64iuatt.htm
"WorldCom becoming one-stop provider," Cnet News, September 8, 1997. http://news.com.com/WorldCom+becoming+one-stop+provider/2100-1001_3-203013.html

[27] "Wireless: Still Too Crowded," *BusinessWeek Online*, May 1, 2006. http://www.businessweek.com/technology/content/may2006/

tc20060501_332841.htm?campaign_id=rss_tech

[28] See, for example: "High-Speed SONET to Your Illinois Door? SBC, Comcast Say No," December 17, 2003. http://www.tricitybroadband.com/news18.htm
See also: "Lafayette hits snag in fiber build," CNet News, February 24, 2005. http://news.com.com/Lafayette+hits+snag+in+fiber+build/2100-1034_3-5589315.html?tag=nl

[29] "BPL Trial Shelved," *BroadbandReports.com*, June 29, 2004. http://www.dslreports.com/shownews/46964

[30] "BPL Growing More Popular," *America's Network*, October 1, 2005. http://www.americasnetwork.com/americasnetwork/article/articleDetail.jsp?id=188591

[31] Ken Kerschbaumer, "Plug-and-Play Internet Wall-outlet broadband attracts heavy hitters," *Broadcasting & Cable*, 7/18/2005. http://www.broadcastingcable.com/article/CA626059.html?display=Technology

[32] See, for example, George Abe, *Residential Broadband*, Cisco Press, 2000, p. 87.

[33] "Bumps in the road for AT&T-BellSouth merger?" C-Net News.com, April 4, 2006. http://news.com.com/Is+the+AT38T-BellSouth+merger+in+trouble/2010-1037_3-6057214.html

[34] Yoo, p. 36 notes that recalcitrant last mile incumbents can make nondiscriminatory access difficult and concludes that such efforts must inevitably fail, notwithstanding the apparent success of in the interexchange market.

[35] Yoo, p. 26, as in the case of mandated interexchange "equal access," Yoo suggests that the program access rules are difficult to implement and assumes they have been a failure, notwithstanding the apparent success in stimulating the growth of DBS.

[36] Time Warner, the second largest cable company, has petitioned the Federal Communications Commission to impose an obligation of nondiscriminatory interconnection on the incumbent local telephone companies, under Section 251 of the Act.

[37] Verizon, the second largest telephone company, has petitioned the Commission to impose an obligation of nondiscriminatory access to video programming under Section 628 of the Act.

[38] At the Senate Committee on Commerce, Science and Transportation hearing on Competition and Convergence, March 30, 2006, representatives of each of these industries pressed their claim to nondiscriminatory access.