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Communications Regulation and Policy Under Convergence:
Advancing the State of the Debate
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COMMUNICATIONS REGULATION AND POLICY UNDER CONVERGENCE: ADVANCING THE STATE OF THE DEBATE

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Abstract

With growing competition and convergence, the entire complex of communications, computing, and multimedia industries has experienced far-reaching technological and institutional change. In the process, the consumption possibilities of end users have been enriched in terms of both the services that are now available and the service providers and delivery systems competing for customers. Because of the pace of change in these directions, the policymaking community is scrambling to sort through a bewildering array of issues. Is regulation still necessary, redundant, or harmful? Where should regulation be directed, if at all? What form should it take—interventionist or passive? Who needs to be protected from whom? How can communications policy be used to improve social welfare? These questions have arisen partly because convergence is a complex and multi-faceted phenomenon and partly because pre-convergence regulatory paradigms and the existing policy apparatus are ill-equipped to deal with it. In this paper, we explore how communications policy must evolve in order to adapt to changing industry circumstances. We propose that any policy or regulatory options in the era of convergence be based on dynamic, rather than static allocative, efficiency. We also explore two particularly controversial ramifications of convergence—network neutrality and video franchising.

Keywords

Convergence, platform competition, traditional regulation, vertically layered policy model, dynamic efficiency, network neutrality, video franchising

1. INTRODUCTION

Liberalization (the introduction of competition) and convergence are, arguably, two of the most significant developments in telecommunications over the past decade. Within a relatively short period of time, telecommunications—indeed the entire complex of communications, computing, and multimedia industries—has experienced far-reaching technological and institutional change. In the process, the consumption possibilities of end users have been enriched in two directions: (1) the number and type of services that are now

available and (2) the number and variety of service providers and delivery systems competing for customers.

The pace of change in these directions has been so rapid and unpredictable that it has left the policymaking community scrambling to sort through a bewildering array of issues. Is regulation still necessary, redundant, or harmful? At what (service, operator, content, etc.) should regulation be directed, if at all? What form should such regulation take—interventionist or passive, *ex ante* or *ex post*? Who needs to be protected from whom? How can communications policy be used to improve social welfare? The questions have arisen faster than the answers have been forthcoming. This is partly because convergence is a complex and multi-faceted phenomenon and partly because pre-convergence regulatory paradigms and the existing policy apparatus are ill-equipped to deal with it.

In this paper, we explore the ways in which communications policy must evolve in order to adapt to the era of convergence. We propose that any policy or regulatory options in that era be based on dynamic, rather than static allocative, efficiency. We also explore two particularly controversial ramifications of convergence—network neutrality and video franchising. The paper is organized as follows. In Section 2, we define and briefly explore the implications of convergence. In Section 3, we review the traditional regulatory paradigm designed for telecommunications in a natural monopoly context and explain why it does not apply in an industry with intermodal competition and convergence. We also explore whether the so-called vertically layered policy model represents a meaningful step forward from traditional horizontal regulation. Finally, we propose designing policy for the convergence era on the basis of dynamic efficiency. In Section 4, we examine the issues of network neutrality and video franchising and suggest solutions based on dynamic efficiency.

2. CONVERGENCE

2.1 Definition

The phenomenon of convergence in the communications industry has many definitions. This is not surprising since it signifies a number of different developments in that industry—some technological, some market-related, and others regulatory. It is instructive, therefore, to consider definitions of convergence that have emerged from various perspectives.

According to the Federal Communications Commission ("FCC"), the agency with federal regulatory oversight of the communications industry in the U.S., convergence means that "providers of communication systems can deliver products and services that compete with the products and services now delivered by other networks."[1] As an example, the FCC cites a cable company that provides local phone service or a local phone company that provides video services.

The European Commission ("EC") defines convergence as "the ability of different network platforms to carry essentially similar kinds of services, or the coming together of consumer devices such as the telephone, television and personal computer."[2] In this more elaborate definition, reference is made to convergence at different levels. In particular, it raises a more nuanced issue—that convergence can mean both intermodal competition (e.g., competition

[1] See FCC (1999), available at http://www.fcc.gov/connectglobe/glossary.html.

[2] See European Commission (1997), available at http://europa.eu.int/ISPO/convergencegp/97623en.pdf.

among alternative delivery platforms for communications services, such as fixed-line networks, mobile networks, cable operators, satellite operators, electric power companies, etc.) *and* integration.

Convergence is sometimes defined with reference to specific contexts, such as the convergence of (1) networks, (2) industries or markets, (3) products or services, (4) firms, and (5) technologies.[3] Examples of each are telecommunications, data, and broadcasting (networks); communications, information, and entertainment (industries); interactive television, video-enabled personal computers, and voice over the Internet protocol ("VoIP") telephony (products/services); joint ventures or strategic alliances among computing, telecommunications, and broadcasting companies (firms); and fixed and mobile telephony (technologies).[4]

A form of technological convergence that has attracted substantial attention in recent years is that between fixed and mobile telecommunications (often called fixed-mobile convergence or "FMC"). Even this form of convergence occurs at three levels: (1) at the network level (one Internet Protocol-based, heterogeneous network that provides voice, data, and video services—commonly referred to as the "triple play"); (2) at the service level (one number and one bill, i.e., one-stop-shopping for telecommunications services and content); and (3) at the terminal level (single, integrated handset that receives/provides all applications/services).[5]

In all of this, two important facts stand out. First, convergence is both integration (of systems, markets, and services) and competition (among technological platforms that can deliver end-to-end service, i.e., from the source of applications or content to the end user). The first trend in convergence enables seamless consumption by end users of essentially complementary components. The second trend provides significant (and even real-time) choice to end users in how, and from whom, they receive services and content. End-to-end intermodal competition eliminates many of the access and essential facility problems traditionally encountered in network industries.

Second, technological competition is both a source of, and a response to, convergence.[6] For example, vigorous competition between fixed and mobile networks is often credited with having prompted FMC. Also, in recent years, the two technological platforms that have emerged as the principal standards in the provision of high-speed Internet access are asymmetric digital subscriber line ("ADSL") and cable modem service. The ability of both ADSL and cable to offer converged services (at least voice and data for now) has spurred competition among telecommunications and cable companies.

2.2 Implications of Convergence

The implications of convergence are far-reaching, on both the demand and the supply side. From the consumer's perspective, probably the most significant implication of convergence is that they soon will be served by "end-to-end" or "soup-to-nuts" networks. Any such network can be a source for the triple play (or "quadruple play" if mobile services are considered separately from fixed voice services). Just as with the purchases we make today of the

[3] See Fransman (2000).

[4] *Id*., Table 3 on p. 37.

[5] See Han *et al*. (2004).

[6] See Fransman (2000).

products of *non*-network industries (e.g., automobiles or food items), it should soon be possible to consume seamlessly communications and multimedia services from network industries. That is, from an end user's standpoint, there will exist real-time choice among alternative (and even technologically different) providers of essentially functionally equivalent services. More importantly, every "layer" that lies between the source of the content or service and the end user—a subject we return to later—will be utilized in a complementary manner to serve the end user, and all those layers will be owned and operated by the same provider.[7]

The second key implication of convergence is also the stimulus for this paper. Convergence is not merely a technological or market-related phenomenon; it also has substantial policy and regulatory ramifications.[8] As convergence continues to blur, and even erase, the boundaries between several technologically distinct sectors, sector-specific regulations (such as those that emerged from the tradition of public utility regulation and were designed for natural monopoly environments) may become, at best, anachronistic and, at worst, irrelevant. This raises several questions. Should there be a parallel convergence of regulatory principles and practices from the converging sectors as well? Should the regulation of the converged industry be placed in the hands of a single regulator? More fundamentally, should traditional regulation be retained for the converged industry? Or should policies for the era of convergence be reconceived from the ground up? Would those policies have to be interventionist or reactive? Does convergence imply the end to policymaking as we have always known it? If so, which of the traditional sacred cows of telecommunications regulation should we consider giving up? In this paper, we address some of these questions and, in particular, the controversies with respect to network neutrality and video franchising that have been ignited by an increasingly convergent industry.

3. REGULATION AND POLICY UNDER CONVERGENCE

3.1 Traditional Horizontal Regulation

The foundations of traditional regulation of the telecommunications industry—and even some modern variants of that form of regulation—are adapted from the following premises of public utility regulation:

- The underlying physical layer of the industry—commonly called the access or "last mile" network—is a natural monopoly and an essential facility that poses potential barriers to entry and various asymmetric competitive risks for unaffiliated rival suppliers.

- Regulation must attempt to emulate the outcomes of competitive processes by requiring adherence to pricing rules based on allocative efficiency even under second-best conditions.[9]

[7] It is as if the end user can choose to consume orange juice in various forms—fresh (in refrigerated cartons), packaged (in bottles or sealed packs), or processible (in powdered or concentrate form, needing to be combined with water). Whichever form the end user ultimately chooses, every stage of production (and possibly even distribution) comes assimilated in the final product.

[8] For an early comprehensive exploration of this important issue, see Henten *et al*. (2003).

[9] Second-best optimality is the best to which a regulated entity can aspire when it can only maximize its profits or surplus subject to regulatory constraints. See Berg and Tschirhart (1988), pp. 85-91.

These provide the intellectual antecedents for various forms of telecommunications regulation, beginning with rate-of-return (or cost-based) regulation and then various forms of incentive regulation (including price caps, revenue or earnings sharing, banded rate-of-return, and limited pricing flexibility).[10] At their heart, all of these forms of regulation have one thing in common to a greater or lesser degree: they are designed to ensure that end users are not exploited by monopolistic retail service prices and, where interconnection or network sharing with rivals is involved, anti-competitive manipulations of the prices and qualities of essential wholesale services are not possible.

In addition, telecommunications regulation in many countries has been guided by two other imperatives:

- Regulation should be applied separately to individual services or categories or service, where distinctions among them arise not from technical, but rather from geography-based or locational distinctions (such as local, national long distance, and international long distance voice calls).[11]

- The telecommunications industry is subject to extensive network effects or externalities (principally because the value of a network to existing subscribers rises as additional subscribers join) and, therefore, every effort should be made—including, if necessary, the use of regulation-mandated cross-subsidies—to ensure access to, and use of, the public telecommunications network by all segments of the population. This "universal service" mandate translates into a "carrier-of-last-resort" obligation, under which the regulated network provider must be prepared to offer, upon request, service to *any* customer at *any* location. Common carrier principles (including, typically, "just and reasonable" pricing and non-discrimination requirements) commonly apply in these circumstances.

3.1.1 Natural monopoly

The central tenet of traditional telecommunications regulation has always been that the typical *wireline* (or "fixed") telecommunications network designed for voice telephony—and based on the triad of local loop (or, the last mile), switching, and inter-office transport facilities—is a *natural* monopoly. That is, the public switched telephone network ("PSTN") involves, by design, large and up-front fixed capital costs but relatively low incremental operational costs.[12] As a result, the minimum efficient scale ("MES") of operations is so high relative to existing market demand for PSTN services that the most efficient industry structure can have only one network provider. Pervasive economies of *scale* mean that

[10] See Sappington (2000).

[11] In some countries, these distinctions correspond to parallel divisions of regulatory authority. For example, in the U.S., local and short-haul long distance voice telephony are subject to the authority of state regulatory agencies, while long-haul long distance voice telephony (both domestic and international) is subject to federal regulatory oversight. These jurisdictional separations have little to do with underlying technological properties of telephony and frequently encounter seemingly intractable problems, such as with deciding whether *data* calls that are made to Internet sites are "local" or "long distance" in nature and, therefore, which regulatory authority should assert jurisdiction over them. In the European Union, regulatory authority is shared between the European Commission that determines the guidelines for regulation in various wholesale and retail markets and the national regulatory authorities of member states that interpret and implement those guidelines.

[12] In what follows, we use the acronym PSTN to refer to the *incumbent* network provider or carrier, which is typically the regulated entity.

services can be offered at lowest average cost by a single network, not by two or more. In addition, extensive sharing of fixed PSTN facilities by different PSTN services means that economies of *scope* enable joint provision of those services from one network at lower cost than separate or stand-alone provision of those services from multiple networks. These properties of PSTN costs (i.e., declining with volume and sub-additive across services) imply that the preservation of the natural monopoly industry structure is, at least, allocatively efficient—the form of economic efficiency that comes from prices being set at their respective marginal or incremental costs. In reality, the strict form of allocative efficiency cannot be applied to the pricing of PSTN services because such pricing cannot recover the large fixed (and often sunk) costs of the PSTN's facilities. Allocative efficiency is thus sought to be applied in a second-best sense by permitting the network provider to mark up its prices above underlying incremental costs in some optimal way (of which the Ramsey rule is one example) so as to enable the full recovery of costs. However, to prevent any exercise of market power by the PSTN under these circumstances, regulatory authorities, rather than the network provider itself, get to determine how (and how much) individual PSTN service prices may depart from incremental costs.

3.1.2 Liberalization and competition

Despite natural monopoly conditions, many countries have successfully liberalized their telecommunications markets and introduced competition to various degrees for their PSTNs. This has been accomplished not by encouraging unbridled duplication of the PSTN or fostering only service resale but by policies that mandate network-sharing or the "unbundling" of the PSTN's essential facilities at putatively cost-based prices determined by regulators. For the most part, the facilities at issue have been those associated with the last mile, which are both the largest component of network cost and sunk. Therefore, in an interesting (and counter-intuitive) twist, the inherent natural monopoly structure of the PSTN has been placed at the service of competition itself, by enabling rivals to build their businesses and overcome their sunk costs at entry before embarking on the construction of their own network facilities. More precisely stated, mandatory unbundling policies have had the effect of making fixed-line markets "contestable."[13]

Unfortunately, although ostensibly based on an application of allocative efficiency (primarily by making the PSTN's essential wholesale facilities available to rivals at prices based on putative incremental costs), actual unbundling and interconnection practices intended to develop telecommunications competition have been mired in controversy. Most often, prices set for unbundled PSTN facilities have been based not on a carrier's actual economic costs, but rather on costs calculated for an hypothetical, most-efficient carrier that operates its network at or near full capacity and exploits all available economies of scale. Predictably, prices for unbundled facilities based on hypothetical costs that generally underestimate actual costs have encouraged inefficient competitive entry and skewed competition by inducing rivals to rely excessively on those facilities rather than on their own.[14] This has had the

[13] See Baumol *et al*. (1988).

[14] See Hazlett *et al.* (2004). Controversy has also marked actions taken by regulators to relax some of the original unbundling rules. In early 2005, to the dismay of rivals that depended heavily on artificially cheapened unbundled PSTN facilities to compete, the FCC decided to drop (after a suitable transition period), circuit switching from among the PSTN facilities subject to the mandatory unbundling rule and weakened that requirement for some other network facilities. The FCC found that competitive alternatives to PSTN switching facilities abounded and were being deployed by rivals, signifying that those rivals were no longer "impaired" (i.e., critically disadvantaged without fair access to an essential facility). See FCC (2005), ¶199. The FCC's move—controversial as it proved to be—accorded with a recommendation made earlier that

unintended (but also entirely predictable) consequence of dampening incentives of both the PSTN and its rivals to invest in new or additional network facilities.[15] In other words, misapplication (or controversial application) of *ex ante* regulation, originally intended to vitiate the market power of natural monopolies and to develop competition in accordance with allocative efficiency, has only succeeded at obstructing *dynamic* efficiency, an issue we examine at greater length below.

Whatever the virtues of traditional *ex ante* regulation based on the natural monopoly model, recent technological developments (in particular, in technological alternatives to the fixed PSTN) and convergence have rendered concerns about the vitality of *fixed-line* competition less important. Two developments appear to be particularly noteworthy. The first is the advent of intermodal competition. The second is the increasing consumer demand for single-source provision of the triple play, a development that is prompting intermodal networks to deploy end-to-end delivery platforms that contain sufficient and reliable bandwidth and can deliver services at affordable prices.

To summarize, traditional regulation has been horizontal in all respects, with regulatory authority frequently shared or distributed on jurisdictional grounds. Allocative efficiency has been the centerpiece of *ex ante* regulation, and such regulation has been intended (if not always properly designed) to prevent the *anticipated* market power, while preserving the efficiency incentives, of natural monopoly. Regulatory policies and certain key policy instruments (e.g., interconnection, service resale, and mandatory unbundling of essential network facilities) have been used to engineer the growth of fixed-line competition by enabling rivals to avoid entry barriers in the form of the enormous sunk costs associated with building their own (essentially duplicative) networks. The results of such policies have, however, been decidedly mixed. Furthermore, changing technological and market circumstances have altered the competitive landscape itself, by promoting a wider array of possibilities that arise from vigorous intermodal competition and relegating the more narrowly-defined competition among fixed-line carriers alone to a less prominent status.[16] These developments have made traditional regulation obsolete and made it necessary to seek a fundamentally different approach to regulation.

3.2 Is Vertical Regulation According to a Layered Model Any Better?

In recent years, consdierable new thinking has been directed at the shape and form of the telecommunications network in an era of convergence. Regardless of the many variations that have been put forward on this theme, a strong consensus exists that the network under convergence will be broadband and Internet-centered, i.e., based entirely on packet-switching, rather than the circuit-switched, narrowband PSTN that has served telecommunications needs for so long. In particular, this vision of the Internet-centered

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mandatory unbundling policies should only be adopted with the welfare of consumers in view, not that of the PSTN's rivals. See Hausman and Sidak (1999).

[15] See Haring and Rohlfs (2002), Haring *et al*. (2002), Eisner and Lehman (2001), Crandall *et al*. (2004), Jorde *et al*. (2000), and Pindyck (2004).

[16] In the U.S., federal policymakers are currently actively engaged in a broad, and sometimes confusing, effort to draw up new telecommunications legislation that recognizes and reflects the changing circumstances. Only a decade after it was enacted, the limitations of scope and vision of the Telecommunications Act of 1996 are being increasingly acknowledged. The EC is itself in the middle of a significant overhaul of its "new regulatory framework," adopted as recently as 2003 and codified in its Framework Directives. Of particular concern to that agency are the implications of recent technological developments and convergence.

network proposes an end-to-end design in which all intelligence resides on the edges and the physical network itself remains neutral at all times to the applications and content that are demanded and supplied over it.[17] In effect, this shifts control and the ability to discriminate from the underlying network to end users and application and content providers, a matter that we examine at greater length later. For now, it is sufficient to contrast this alternative view of the telecommunications network under convergence with the longstanding PSTN, and to explore whether that contrast implies an alternative way to design regulation as well. Because it can control last mile access to end users and the flow of services to them, the PSTN has been subjected to common carrier regulation around the world. If such control no longer exists in an Internet-centered network, what must replace the horizontal regulation that has long been applied to telecommunications?

Several proposals in recent years have sought to replace horizontal telecommunications regulation long considered to be appropriate for the PSTN with a vertically layered model considered more suitable for an Internet-centered network. In 1978, the Open Systems Interconnection ("OSI") Reference model—the original layered model developed by the International Organization for Standards—presented a seven-layer view of network ***design***. Some observers believe that the OSI model can be adapted to the formulation of ***policy*** as well in an era of convergence.[18] One such formulation views the network as consisting of four layers stacked from bottom to top in the following order: (1) physical layer, (2) logical layer, (3) applications or services layer, and (4) content layer.[19] Although the layers in the OSI model were intended originally to identify the discrete successive functional steps in a network that are needed to convey content all the way to the end user, various authors saw that model—particularly in the truncated form advocated by Werbach—as a sound basis to formulate telecommunications policy as well.

For his vertically layered model, Werbach proposed that regulation should be directed, at a minimum, at the lower layers (especially the physical layer or the underlying network) because "openness at one layer allows for innovation at higher layers."[20] Other scholars have also proposed matching the structure of regulation in the layered model to the design principles established for the Internet.[21] Based on these pronouncements, the former MCI even put forward a policy advocacy paper calling for a restructuring of telecommunications regulation in accordance with the layered policy model.[22] In that paper, MCI proposed to

[17] See Saltzer *et al.* (1984).

[18] See, e.g., Werbach (2002).

[19] *Id*., p. 59.

[20] *Id*., p. 60.

[21] See, e.g., Lemley and Lessig (2001). The authors conclude: "The Internet has been such a fast-growing network because it has enabled extraordinarily innovative competition. It has been architected, through the [end-to-end] design, to enable this competition." *Id*., p. 971. Also see Frieden (2003). This article's support for the layered policy model is qualified by the author's belief that, although it would "reduce the number of regulatory asymmetries and inconsistencies," regulation based on such a model could be "politically unacceptable." *Id*., p. 214. [We note the potential for some terminological confusion because what Professor Frieden calls "vertical" regulation is actually described by Werbach—and this paper—as "horizontal" regulation, and *vice versa*.] Echoing other proponents of the layered policy model, Frieden claims that a "horizontal orientation also would establish a regulatory regime based on how technologies function and would foreclose the need to make semantic distinctions between such converging concepts as telecommunications used in the provision of information services and telecommunications services provided directly to users." *Id*.

[22] See Whitt (2004).

retain essentially all of the underpinnings of common carrier regulation. It argued that market power is most likely to reside in the physical layer (the network); therefore, continued regulation of that layer is needed to ensure that it stays "open" to the upper layers and to prevent monopolistic leveraging from the physical layer into those upper layers. In essence, all that changed in MCI's policy formulation was merely the architecture of the policy model, not the underlying regulatory regime itself.

The MCI policy advocacy paper attracted vigorous rebuttal from several scholars[23] who denounced the paper for essentially putting old wine into new bottles. Some noted that nothing would change from traditional horizontal regulation in which the thrust of all *ex ante* regulation was to prevent the exercise of market power by network owners. Others noted that the MCI paper failed to address the issue of whether market power (principally in the form of the last mile bottleneck) remained a serious enough problem in an era marked by convergence and significant intermodal competition to warrant continued common carrier regulation under another guise. In addition, many lamented the serious disincentives for broadband network investment that would inevitably follow any adoption of the MCI policy proposal. Finally, the MCI proposal was rejected on the grounds that it would likely (1) increase, rather than reduce, government intervention, particularly for segments of the communications industry not previously regulated (e.g., wireless); (2) eliminate efficient price discrimination as a way to prioritize network traffic and better manage network resources; and (3) build in rigidities that would prevent regulation from adapting quickly and flexibly to change introduced by innovative technologies that are almost certain to supersede the Internet as it currently exists.

We are sympathetic to the criticism that MCI's policy advocacy based on the layered policy model does *not* represent a major transformation from the fundamental precepts of traditional regulation. At its core, it still represents a view of natural monopoly in the network (in particular, the last mile) albeit one embedded within a broader view of the connections between the network and end users on one end and different sources of services, application, and content on the other. MCI's open access requirement for the physical layer is thus little different from the traditional common carrier obligations of PSTNs. Also, as some scholars have noted, even this policy position must be predicated on the premise that the provider of last mile connections remains a natural monopoly capable of exercising market power unless checked by regulation. To the extent, therefore, that realistic competitive alternatives exist for last mile connectivity, as would be expected under convergence, neither traditional horizontal regulation nor an open access requirement for the physical layer in the layered policy model can any longer have any policy relevance. If the purpose of regulation is to ameliorate market failure, suppress opportunities for the exercise of market power, and foster outcomes that are expected in competitive markets, then it is hard to see how simply replacing traditional horizontal regulation with an MCI-style rendition of the layered policy model can be an improvement.

In our view, any replacement for traditional horizontal regulation must have a rationale that is both forward-looking and attuned to actual competitive developments in the market. In the next section, we explain that the advent of multiple alternative intermodal platforms for delivering communications and multimedia services has reduced considerably the last mile problem and attendant natural monopoly characteristics that once were the *raison d'être* for

[23] See the contributions of James L. Gattuso, Wayne T. Brough, Braden Cox, David P. McClure, Andrew Odlyzko, Stephen Pociask, Adam Thierer, and Glenn A. Woroch in New Millennium Research Council (2004).

common carrier regulation. At least in large part because of this development, we believe it is imperative that the cornerstone of communications policy shift from static allocative efficiency to dynamic efficiency.

3.3 Setting a New Policy Direction

3.3.1 Are new policies needed?

It is a tautology that telecommunications policy must reflect, and be based on, technological and market realities in the telecommunications industry. Yet, as we explained in the previous section, telecommunications regulation—whether actual or proposed—has not moved far from the pre-convergence era, PSTN-centered, natural monopoly-based model of the industry. As fundamental technological change permeates this industry, long-held views of how networks function and for what purpose are being seriously challenged.[24] The PSTN architecture in which all the intelligence resides inside the network is yielding to the Internet-centered architecture in which that intelligence resides at the edges of the network. The "smart network, dumb user device" network is being transformed into the "dumb network, smart user device" network. This change is profound for a number of reasons.

First, unlike the PSTN, the Internet-centered network cannot influence or affect transmissions (whether of voice, data, or video images) among end users or "hosts." Those transmissions, made in the form of Internet Protocol ("IP") packets, are routed not over pre-selected or dedicated paths within the network but over paths available at any instance of time that can convey the packets with greatest efficiency or least resistance. Clearly, the network owner retains some degree of control within the PSTN but not so within the Internet-centered network.

Second, because content and applications are generated, demanded, and supplied at the edges of the Internet-centered network, the network itself cannot be used as an instrument to discriminate unduly, manipulate content, or limit access to end users. This is a significant liberating force in and of itself: it reduces the network's role to simply that of a neutral facilitator or agnostic delivery system and, therefore, a suitable launching pad for innovation by content providers and users. For example, communications (whether through voice, data, or video) can now occur among devices attached by various hosts or nodes along the edges of the network *without* a concurrent requirement that those devices conform to some pre-set standards of compatibility. It is only necessary that the device in question—whether a telephone, a computer, or some portable electronic device—be compatible with the underlying *software* that drives the IP transmissions. Thus, end users and content providers are empowered to use a variety of devices to attempt communication in one form or another. The PSTN is incapable of fostering innovation in this manner.

Third, the PSTN's last mile problem, which is essentially an artifact of the "smart network, dumb user device" configuration, is easy to cure in an Internet-centered network. In the latter, there are no available means to use the network to direct or deny either specific forms of service or access to service providers and users. This provides an excellent opportunity for alternatives to standard, PSTN-based, fixed-line access to develop, such as with broadband wireless, cable, satellite, power lines, etc. In fact, it is now not uncommon in some countries

[24] For a comprehensive description, see Hatfield *et al.* (2005).

for end users to be able to choose among multiple last mile technologies, and the dropping cost of bandwidth media is making even real-time choices among such technologies possible. What was once a critical and vexing limitation of the PSTN (or fixed-line networks generally) is now an opportunity for unprecedented network diversity.

In these circumstances, the Internet-centered network solves many of the policy conundrums associated with essential facilities, the last mile, market power, etc. Wherever bottlenecks arise, the end-to-end and neutral nature of such a network also makes possible the bypass solution that puts end users and content or applications providers, not network owners, in charge. In such a pure state of the world, telecommunications regulation could almost become unnecessary. Skeptics of such a view may argue, however, that even if the *public* Internet became immune to manipulation or control, regulatory checks would still be required to ensure that *private* networks connecting to and interacting with the Internet remain open and accessible by both end users and service providers. This would not be an unreasonable argument for retaining some of the traditional policy controls over network owners. However, as we have noted above, alternative last mile technologies now abound. Without the access monopoly that was the preserve of the PSTN, it seems highly unlikely that private networks can successfully exercise control over end users and service providers. It seems to us that a more fruitful inquiry about telecommunications policy options for the era of convergence would be one that steps out of the historical "prevent mode" into one that encourages the emergence and growth of viable intermodal alternatives to private PSTNs (even those reincarnated as broadband services).

3.3.2 Policies based on dynamic efficiency

We propose that the cornerstone of communications policy in an Internet-centered world and an era of convergence should be *dynamic* efficiency. The efficiency implications of policy measures have been studied widely but, in general, only measures of *static* efficiency are considered. The two most common such measures are (1) allocative efficiency (defined above), which measures whether a firm has chosen the optimal allocation of input resources, given prices for those resources, and (2) technical or productive efficiency, which measures whether a firm has maximized output given a set of input resources. Unfortunately, these measures of efficiency—on which telecommunications regulation has traditionally been based—do not properly account for the dynamic and evolving nature of the telecommunications industry.

Strict application of the allocative efficiency principle restricts a firm to charging service prices that exactly recover corresponding marginal (or incremental) costs. Because that is insufficient for a natural monopoly to recover its large fixed costs, such a pricing rule cannot always be applied exactly. Optimal regulation must then ensure that the natural monopoly recovers its total costs by marking up its service prices in a manner that minimizes the loss of allocative efficiency that follows from such pricing.[25] In reality, telecommunications regulation has rarely been optimal in this sense, even though allocative efficiency has provided the underlying inspiration for such regulation.[26]

[25] See Train (1991).

[26] The role of allocative efficiency is evident even in antitrust or competition policies adopted in the U.S. and the European Union. For example, the prime concern with market power is that enables a firm to violate the allocative efficiency rule with impunity and, therefore, its mitigation (through some instrument of policy) is desirable on grounds of efficiency alone.

The main limitation of the static allocative efficiency rule is that it does not perform nearly as well when guiding policy outside the confines of a natural monopoly setting. Competition is a dynamic and unsettling process, as firms employing alternative technologies, production methods, and marketing techniques vie to attract customers. Over time, consumer preferences help to establish standards and protocols and to determine which service (or variant of a service) survives and which does not. Innovation occurs in response to new possibilities and is fueled by inventions or new ideas that often generate short-term rents or first-mover advantages. In the course of this birth-and-death process, investments are made or abandoned, and firms incur upfront (and often sunk) costs in the expectation of recovery at later times.

In this environment, it is more reasonable to believe that how efficiently resources are used *over time* is more important for social welfare than whether the allocative efficiency rule is satisfied at any given point of time. That is, if efficiency is viewed in dynamic terms, transitory or momentary performance should not matter. Therefore, any regulation that attempts to shepherd the competitive process along must have dynamic, rather than static allocative, efficiency as its cornerstone. Moreover, actions or choices that turn out to be dynamically efficient over time need not be allocatively efficient at any instant of time. That is, dynamic (Schumpeterian) competition based on significant capital and long-term commitments, by its very nature, cannot fulfill the requirements of static allocative efficiency, and it is futile to build meaningful telecommunications policy around static efficiency principles.

With dynamic efficiency as the centerpiece of telecommunications policy in an era of convergence, several policy conundrums are likely to fall by the wayside. The following provide some examples of this possibility.

3.3.2.1 The last mile problem

Perennial concerns with the last mile problem under PSTN-based, fixed-line competition are likely to disappear as alternative technologies or platforms compete among each other to provide end-to-end service to end users and leave them in greater control over network access and devices needed to receive service.[27] On the flip side, rivals that depend on network-sharing rules or other policy mandates to gain access to the PSTN's network and end users can resort to alternative delivery technologies.[28] Service and content providers, in particular, need not own or control their own networks to produce and deliver innovative services in these circumstances. Mandatory unbundling rules and contentious pricing rules for unbundled facilities need no longer be a policy imperative.

3.3.2.2 Technological developments

Adopting dynamic efficiency as the guiding principle would enable policymakers to avoid perpetually having to play catch-up with technological progress. The history of

[27] See Hatfield *et al.* (2005).

[28] In the U.S., the terms on which regulated incumbent carriers had to provide unbundled network access to their rivals have proved to be the most contentious (and litigious) issue for regulators implementing the Telecommunications Act of 1996. For an early forecast of how this issue would eventually turn out, see Crandall (2000). Seven years after its implementation of mandatory network-sharing rules, the FCC publicly questioned its own assumptions underlying the formulation of those rules. See FCC (2003), especially ¶¶49-54.

telecommunications regulation is replete with instances of bypass or alternative technological solutions that have rendered existing regulations ineffective or unnecessary. Convergence, whether through integration of alternative technologies or strong intermodal competition, is itself performing that function. Rather, this is an opportune time for policymaking to follow, rather than attempt to lead, technological developments. Because dynamic efficiency allows for assessments to be made about how well an industry performs over the longer run, *ad hoc* or even well-conceived but controversial policies no longer have to be formulated to deal with one-off or transitory problems of inefficiency in the industry. This restraint or caution can protect policymakers from unwittingly *creating* opportunities for regulatory arbitrage that further feed on the distortions that give rise to responsive but faulty policies in the first place.[29]

3.3.2.3 Universal service

Nowhere is conflict among policy desiderata better epitomized than by that between the need to craft regulation based on allocative efficiency (or optimal second-best departures from it) and the social goal of universal service (assuring accessible and affordable service to all citizens). The universal service goal is usually justified by the network effects and externalities associated with the telecommunications industry. Since increasing subscribership is believed to increase the economic value of the network to those served by it, most countries have adopted universal service (or, to a lesser degree, universal access)[30] policies. These rely on generally available or targeted subsidies to encourage marginal subscribers (usually the most indigent or those in the lower demographic echelons) to join and stay with the network, even if they do not originate many calls of their own.

Traditional regulation's formula to ensure this has been to subsidize network *access* services (i.e., price them below incremental cost) by obliging carriers to mark up their *usage* services above incremental cost. This formula is, on its face, an outright and policy-sanctioned violation of the allocative efficiency rule, but is usually justified by the argument that the costs of that violation are compensated by the internalization of the network and call externalities generated by expanding network subscribership. Unfortunately, cross-subsidies of this form generate significant deadweight losses,[31] are wasteful,[32] and cannot be sustained

[29] One of the most troublesome instances of this has arisen with respect to the design and implementation of inter-carrier compensation. Under traditional regulation, one carrier compensates another carrier whenever the latter transports or terminates traffic originated by the former (or, more precisely, the former's end user). In the U.S. and elsewhere, the precise form and magnitude of the compensation has depended more on artificial jurisdictional or geographic characterizations of the traffic in question (e.g., local, long distance, Internet-directed, etc.) rather than on functions performed or actual cost characteristics. Predictably, this has induced interconnecting carriers to either attempt to re-characterize the traffic or otherwise game the compensation process so as to be able to maximize inter-carrier receipts or minimize inter-carrier payments, as the case may be. The public Internet, on the other hand, is based on a model of peering in which interconnecting networks essentially "bill and keep," thus avoiding opportunities for arbitrage of this nature. See Economides (2005). In an Internet-centered world, ubiquitous peering arrangements can be expected to make inter-carrier compensation a non-issue (or, at least, a much reduced issue) and offer welcome respite to policymakers.

[30] Definitions can vary for these terms. In one usage, universal service refers to the ready availability of affordable basic telephone service (and possibly other services) to every *household*, while universal access refers to such availability at some appropriate community access point (such as a conveniently located telephone or Internet café).

[31] See Hausman (1998).

under competition and convergence.[33] Also, it is unclear from an empirical standpoint, just how much economic benefit flows from the capture of the supposed network externalities (especially in developed countries where network subscribership rates are already high) and whether that benefit overcomes the inefficiencies and other costs associated with any subsidy-based program in increasingly competitive markets.[34] In these circumstances, the best hope for successful universal service policy may well lie in scrapping cross-subsidies altogether in favor of funding from general tax revenues (whether secured from firms of all stripes in the communications industry[35] or the wider economy).[36]

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[32] If the purpose is to encourage those on the margin to join the network, making network access affordable can be a valid reason for an access subsidy. However, that does not answer the question about why such a subsidy should be generally available and not be targeted only to those who really need it.

[33] Non-sustainability arises from the fact that the universal service "obligation" is generally imposed on regulated incumbent carriers that provide network access services. However, depending on country, other carriers are frequently exempted from that obligation and may choose not to provide network access and other services to certain end users (e.g., if they do not prove to be lucrative). Carriers that bear the burden of universal service and rely on cross-subsidies cannot compete with rivals that do not share that burden and can offer usage services at lower, non-subsidy-contributing prices. A partial solution to this asymmetry can come from requiring ***all*** carriers, regardless of whether or not they are directly responsible for providing network access, to contribute the same percentage of their revenues to an external funding source set up to subsidize network access services. However, under convergence, the non-sustainability problem can be potentially aggravated if certain intermodal competitors (such as cable, satellite, and electric power companies, or broadband service providers generally) are selectively exempted from this contribution requirement. In the U.S., this problem is proving to be particularly intractable because of the existing dichotomy established two decades ago by the FCC between "telecommunications" and "information" (or "enhanced") services. Predictably, providers of information services (in the U.S., defined as those that can alter, store, or utilize the content of telecommunications, such as providers of data or video services) are strongly resisting any effort to make them contribute to a universal service fund, claiming that any such requirement would chill broadband investment. A similar dichotomy has been adopted by the European Union. See, e.g., the European Commission's Framework Directive and the earlier Directive 98/48/EC and a subsequent amendment of it.

[34] If, as some studies indicate, the price elasticity of demand for network access is "very low" (and certainly in the inelastic range), then lowering the price of that access through a subsidy is unlikely to stimulate even a proportional increase in subscribership. In that event, the benefit from internalizing the supposed network externality may not be substantial enough to overcome the costs imposed by subsidy-related distortions. See, e.g., Rohlfs (2005) and Riordan (2001).

[35] Some observers contend that any universal service program should be funded entirely by network or infrastructure providers because such a program only concerns network access and benefits only carriers that provide such access. See, e.g., Douglas C. Sicker, available at http://www.si.umich.edu/tprc/papers/2002/95/TPRC_Layered_model.pdf#search='sicker%20mindel%20Telecommunications%20Policy'. We disagree with this argument. Increased network access is a ***sine qua non*** for increased sale of usage services (applications and content in the layered policy model) as well. Providers of complementary services, particularly in an era of convergence in which IP networks are becoming increasingly prominent, also have a stake in rising network subscribership and must be asked to share in supporting any universal service program. Failure to do so would cause another form of regulatory arbitrage and distortion, e.g., by biasing competition between pure application and content providers and network-based carriers that offer competing services in favor of the former group. See, e.g., the discussion of complementary bandwagon effects of increasing access to, and usage of, the Internet in Rohlfs (2005).

[36] The "fatal attraction" of inefficient cross-subsidies cannot be overstated. Some observers have correctly noted that the clamor to expand the traditional definition of universal service in the U.S. and Europe to now include Internet access could, regrettably, also mean the expansion of cross-subsidy support schemes. See Cawley (2000). Also see Latzer (2000). We agree that it makes little sense from efficiency (static ***or*** dynamic) and sustainability standpoints to perpetuate the use of cross-subsidies to support universal service (however defined) in an era of convergence.

Better still, in an era of convergence, the appropriate policy would be to secure universal service (or access) indirectly by encouraging progressively lower-cost access technologies to emerge—thus steadily diminishing the size of the requisite support fund—even if pioneering technologies (and those that deploy them) earn rents and enjoy first-move advantages for some time. From a dynamic perspective, it would be more efficient in a converged environment to let the market (and competition) evolve the appropriate access solutions,[37] rather than to rely on politically attractive but ultimately inefficient cross-subsidies borne by incumbent carriers or on external support funded by only a hapless subset of service providers.

3.3.2.4 Market power

Some of the most convoluted transformations in telecommunications policy in recent years have concerned the appropriate roles of *ex ante* and *ex post* regulation.[38] Traditional regulation has been more *ex ante* in nature, with the general purpose of either preventing undesirable conduct (by regulated carriers) or outcomes or actively fostering competition in certain desired forms or directions. Such regulation is necessarily anticipatory in nature, sector-specific, and intended to shape behavior—of regulated incumbents directly and of unregulated rivals or other entrants indirectly. U.S. telecommunications regulation best epitomizes this direction. On the other hand, antitrust or competition policies that have come to the fore in recent years are neither anticipatory nor sector-specific. Moreover, their purpose is to shape or modify behavior in an "after-the-fact" fashion, through investigations and enforcement actions in response to allegations of anti-competitive conduct (such as means pursued to monopolize or otherwise control the market). The New Regulatory Framework of the European Union more closely adheres to *ex post* policies. Under this framework, national regulatory authorities ("NRAs") in the member states conduct significant market power ("SMP") investigations in accordance with directives issued by the EC.

Market power is the central focus under both formulations, although *ex ante* regulation tries to prevent it from developing in the first place, while *ex post* regulation provides the means to detect and mitigate it if it exists. Economic theory defines market power as the ability to profitably raise and sustain the price of a good (or service) above the level that would prevail in a competitive market.[39] Although this definition is vague as to the precise form or contours of the "competitive market," it is reasonable to infer that the underpinning principle is allocative efficiency. Thus, under both *ex ante* and *ex post* regulation, suspicion about market power almost automatically attaches to any price above incremental cost (because marginal or incremental cost pricing is a fundamental precept of "perfect" competition). Yet, telecommunications carriers and network operators invariably find it necessary to price their services above incremental cost in order to recover all of their costs—precisely the form of pricing that could trigger a market power investigation.

[37] We see echoes of this point in the assertion that universal service once represented merely a goal of providing connectivity to every household but now should mean that "people [can] actively choose the configuration of their access" from a "menu of technology and payment choices"—a dynamic and empowering process, rather than a passive one. See Schement and Forbes (2003).

[38] For a comprehensive examination of trends in telecommunications regulation, see Geradin and Sidak (2005).

[39] See, e.g., Carlton and Perloff (2000), p. 610.

Even if it is recognized that telecommunications markets cannot fully conform to the pricing formulas of a perfectly competitive market, or that optimal departures from incremental costs may actually be second-best efficient rather than anti-competitive behavior, there can be significant confusion in proving market power. For this reason, market power investigations frequently rely on more measurable metrics like market share on the premise that firms with higher market shares are more capable of pricing monopolistically or earning "excessive" profits.[40] However, this inextricably ties high market share (however defined) to a presumption of market power and its corollary, monopolistic pricing. In regulated network industries like telecommunications where incumbent operators have had historically high (albeit falling) market shares from the times they were allowed to operate as regulated natural monopolies, this approach to testing for market power can be misleading. Moreover, market shares are "backward-looking" in nature and, thus, not a valid basis for predicting future pricing conduct. In a contestable market, for example, even small rivals can effectively check the pricing power of a relatively large incumbent.

Moving to a dynamic efficiency basis for formulating telecommunications policy can significantly ease some of the problems inherent in market power-centered investigations and enforcement. For one, second-best pricing of services would not automatically be seen as a manifestation of market power and be prosecuted as such. Rather than view them with suspicion, policymakers would regard technological advantages and product differentiation (and, especially, the short-term rents and first-mover advantages they generate) as contributing to the dynamically efficient development of the industry.[41] That would lead to policies that remove the fear of undue expropriation and preserve incentives for further investment and innovation. In an era of convergence, asymmetric regulation of incumbent fixed-line carriers is neither efficient nor necessary, particularly when competition among alternative delivery platforms and end-to-end service provision have become the norm.

3.3.3 General policy lessons for convergence

There are three clear lessons for policymakers regarding the post-convergence world:

- Greater regulatory restraint (particularly regarding *ex ante* regulation) is likely to become virtuous policy. With the collapse of the natural monopoly model, and the resulting immateriality of static allocative efficiency as a guiding principle, the pre-

[40] Prior to the adoption of the new regulatory framework in 2003, the EC relied solely on a market share threshold (25 percent to be precise) for its test of market power. Under the new regulatory framework, an SMP assessment would still have to begin with a finding that an operator has a "high" and stable (over time) market share (i.e., a "dominant" position) but then expand to include consideration of other factors like size, control of essential network facilities, scale and scope economies, technological advantages, access to capital markets, extent of sales and distribution channels, potential competition, etc. See European Commission (2002). In particular, the EC has defined SMP as being present if an operator can "raise prices by restricting output without incurring a significant loss of sales or revenues." *Id.*, ¶75.

[41] The blind application of *ex post* regulation in an era of convergence can be hazardous, to say the least. Antitrust investigations of market power necessarily start by defining the relevant economic market (in both its product and geographic dimensions). With convergence, market definition takes on a special urgency and complexity. The scope of the product market is typically determined by the extent of substitution that is possible for the product in question. With true convergence and inter-platform competition, the scope of the market for even something as mundane as voice communications can be quite difficult to define. Also, the EC's current practice of directing NRAs in member states to conduct SMP investigations in 18 arbitrarily defined retail and wholesale markets already has shaky conceptual foundations, and the existing problems with market definition can only get worse under convergence.

convergence policy preoccupation with *preventing* the emergence or exercise of market power will no longer be a pressing priority.

- Using dynamic efficiency as its new guiding principle in a post-convergence world, telecommunications policy must become much more directed at encouraging the emergence and growth of new technologies and platforms, new market institutions, and new forms of packaging of services and content. This may mean taking the longer, *inter-temporal* view of resource allocation and utilization, and may mean refraining from using regulation to eliminate short-term rents and first-mover advantages. Fostering competition within each layer of the layered policy model should become the policy priority under convergence, but with a focus of letting the market work despite short-term departures from allocative efficiency. If necessary, regulators can always resort to competition policies or *ex post* regulation to mitigate proven instances of market power, although it bears remembering that conducting market power investigations may well prove to be difficult and contentious in the post-convergence world (for some of the reasons noted above).

- The most noteworthy feature of the post-convergence world is likely to be the primacy of the end user. In this view, under convergence, the end user, not the network provider, is likely to be in charge.[42] Rather than passively receiving services from a menu of sorts made available, and under terms set, by the network provider, the end user will have the opportunity and the means (through smart devices that can be connected to the network) to relate to network and service providers interactively and, more importantly, make active, real-time choices of services and content as well as of who should provide or transport them. With the end user at the helm in this manner, not only will the longstanding model of regulation of the network or service provider lose any justification, but some of the most cherished instruments of that regulatory model (including the insistence on general non-discrimination, as part of a network provider's common carrier obligations) will have to be discarded.

4. EMERGING POLICY ISSUES UNDER CONVERGENCE

4.1 Emerging Policy Issues

Convergence is already underway, to a greater or lesser degree, around the world. Carriers with converged networks and belonging to the Fixed-Mobile Convergence Alliance ("FMCA") are leading the way with FMC in over 20 countries.[43] In the meantime, convergence in the sense of end-to-end intermodal competition is also heating up as all-fiber networks with very high capacities supplant completely the older, all-copper or copper-fiber hybrid networks that currently serve narrowband and broadband service needs.[44] As these

[42] As we note in the next section, even the FCC takes this view.

[43] These carriers and countries include AT&T (USA), Belgacom (Belgium), Bezeq (Israel), Brasil Telecom (Brazil), BT (UK), Cegetel (France), Cesky Telecom (Czech Republic), Eircom (Ireland), KPN (Netherlands), KT (South Korea), NTT (Japan), Optus (Australia), PCCW (Hong Kong), Rogers Wireless (Canada), Swisscom (Switzerland), TDC Mobil (Denmark), Telecom New Zealand (New Zealand), TeliaSonera (Finland), Telecom Italia (Italy), Telkom SA (South Africa), and TRUE (Thailand).

[44] NTT in Japan is currently embarked on building a nationwide, end-to-end, all-fiber network by 2010. This contrasts with the copper-fiber integration approach that BT has taken in the U.K. See McClelland (2006). Also available at http://www.telecommagazine.com/article.asp?HH_ID=AR_1889.

transformations to "next generation" networks open up new consumption possibilities (such as IP television or "IPTV"), the policymaking community is being roiled by new controversies that are, at least partly, the making of some of the existing policies themselves. Two good cases in point have arisen in the U.S., where regulatory and legislative battles are currently raging over (1) network neutrality and (2) video franchising for telecommunications carriers.[45] These issues are, in some respects, artifacts of regulatory policies in the U.S., but could conceivably play out in other countries as well. In this section, we examine these unfolding issues through the lens of dynamic efficiency-based policies.

4.2 Network Neutrality

Perhaps the most striking feature of the so-called network neutrality debate is that there does not appear to be a common definition of the term "network neutrality" itself. In fact, for all the intensity of the debate, opposing parties sometimes seem to be talking past each other. Consider the following summary of the positions of the protagonists on both sides.

4.2.1 Arguments in favor

Calls for adopting network neutrality as the governing law under convergence have been based on the premise that "a bit is a bit is a bit." That is, with digitization of voice, data, and video transmissions, it makes no sense to treat them differently (*a la* the "telecommunications service" vs. "information service" dichotomy) or price discriminate on the basis of whether the bit provided is for voice service or for video service. Hence, proponents of network neutrality argue, the most sensible policy for fostering continued growth and innovation in an Internet-centered communications world is to maintain an "open" Internet in which carriers have control over neither what services end users choose to consume and from whom nor what service and content providers choose to provide and to whom. In this view, the intelligence at the edges of the Internet-centered network must be preserved and network owners must not be allowed to interfere with that objective.[46] Others argue that network neutrality would (1) "guarantee" that discrimination cannot occur in the future and thus stimulate present-day application providers to invest more strongly in developing broadband applications and (2) promote a fair form of Darwinian competition among applications, with those emerging as survivors owing their success to end user choices, rather than to interference or bias by network providers.[47]

In sum, the two central concerns of network neutrality proponents are as follows:

- Most end users in the U.S. do not have—and will not have in the foreseeable future—adequate choice of broadband service or even of competing platforms (cable and

[45] As of April 2006, the two issues are the subject of intense debate in various Congressional and public forums. Legislation is in the process of being drafted but consensus on the policies to be adopted is nowhere in sight. The debates have spawned unlikely alignments as well: whereas cable companies and telecommunications carriers are on opposite sides of the video franchising issue, they actually are in a coalition opposing network neutrality rules espoused by content providers and consumer groups.

[46] See Cerf (2006). Mr. Cerf argued that "allowing broadband carriers to control what people see and do online would fundamentally undermine the principles that have made the Internet such a success."

[47] See Wu and Lessig (2003). Alternatively, see Wu (2003).

telecommunications networks "control" 98 percent of the broadband market, and only about half of the end users can even choose among the two).[48]

- Given the duopolistic nature of present broadband competition in the U.S., network providers (particularly cable companies) can use contractual restrictions and network designs to mostly favor the development of one-to-many applications and pursue price discrimination and bandwidth management goals.[49] The great fear is that, without a network neutrality policy, there could be "restriction of new and innovative applications that broadband operators see as either unimportant, a competitive threat, or a chance to make money."[50]

4.2.2 Arguments in opposition

The opposing view on network neutrality contrasts sharply with the democratic Internet vision of its proponents. Opponents point to the efficiency disincentives and potentially chilling effects on broadband network investments of a blanket network neutrality rule.[51] In effect, opponents argue, the "bit is a bit is a bit" view treats every packet of information as exactly the same, regardless of the urgency or immediacy that attaches to its transmission.[52] Given that the *economic* value of certain transmissions (such as voice and video) may be higher the less latency and jitter they experience, or that other transmissions may require prioritizing in view of their urgency, network neutrality would make it impossible to devise pricing and service quality rules that make the most efficient use of available bandwidth. In the process, network neutrality opponents contend, broadband network providers would find themselves ill-equipped to deal with the enormous sunk costs of building their networks and possibly elect to defer or even cancel planned investments.[53]

Opponents also point to various benefits of not implementing network neutrality as a governing principle under convergence. First, they predict that allowing network providers to vertically "integrate" with applications or content providers (i.e., contractually or otherwise favor one set of such providers over others) can actually produce product differentiation and network diversity that benefit end users.[54] Second, encouraging network diversity can actually mitigate tendencies toward concentration in the provision of last mile connectivity that excessive standardization can bring (such as could happen if no price or service quality discrimination were permitted).[55] Third, if the network remains congestible even under convergence, then prioritization (in the form, e.g., of tiered pricing) can make more efficient use of existing capacity and provide the proper price signals to guide both consumption and

[48] See Cerf (2006).

[49] See Wu (2003), p. 144.

[50] See Wu and Lessig (2003), p. 4.

[51] See, e.g., Yoo (2004) and Sidak (2006).

[52] See Sidak (2006). Also see Economides (2003).

[53] Sidak (2006) argues that the high sunk costs of such networks raise the risks faced by network providers and, possibly, also the returns they have to earn on capital. Also, significant scale and scope economies require the use of second-best pricing and efficiency-enhancing forms of price discrimination.

[54] Contrast this claim with that of network neutrality proponents who believe that product differentiation, if any, should be within the control of end users, not network providers. See Yoo (2004).

[55] *Id*.

future investment.[56] Finally, most forms of communication generate "call" externalities, i.e., they occur in "two-sided markets."[57] In those circumstances, it is more efficient to make *both* parties pay to help recover the network's sunk costs, rather than only one of the parties. [58]

In sum, the two central concerns of opponents of network neutrality are:

- Network neutrality would continue certain open access and non-discrimination requirements that characterize the common carrier obligations of PSTN carriers today. This would dampen efficiency and investment incentives for broadband network providers, and delay (or even retard) the emergence of alternative last mile solutions.[59]

- As convergence progresses, most forms of communications will occur in two-sided or multi-sided markets.[60] That prospect presents several options for the efficient recovery of the costs to build converged or next-generation networks. Network neutrality will hurt, not help, efforts to further develop these complicated markets, and deprive end users of many of the promises of convergence.

4.2.3 Current state of the debate

In the U.S., the network neutrality debate has entered the legislative phase. Congress is currently sorting its way through impassioned advocacy from both sides, while it becomes increasingly evident that the opposing parties may simply be talking past each other. This recent debate was sparked, in part, by the publication of a policy statement by the FCC. In this statement, the FCC enunciated four principles in order to "encourage broadband deployment and preserve and promote the open and interconnected nature of public Internet."[61] According to these principles, consumers are entitled to

- access the lawful Internet content of their choice.
- run applications and use services of their choice, subject to the needs of law enforcement.
- connect their choice of legal devices that do not harm the network.

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[56] See Sidak (2006). Also see Gupta *et al*.(2005).

[57] In two-sided markets, both contracting or connecting parties benefit from the same transaction or communication. Hence, the demands of the two parties are complementary. For example, the calling party and the called party may both benefit from a call. A visitor to a web site may benefit from accessing useful information but so may an advertiser that tries to reach that visitor through the same web site. The developer of operating system software can attract interest from both end users and application developers. See Evans (2003). Also, see Borreau and Sonnac (2006).

[58] Some of the most vociferous support for network neutrality comes from content providers like Google, Amazon.com, and Yahoo! which earn substantial revenues from advertisers but are reluctant to share some portion of those revenues with network providers.

[59] Some proponents of network neutrality are more measured in their advocacy and careful not to support an unqualified open access requirement. They also concede that the neutrality principle ought only to apply to the public Internet, not local (or last mile) private networks. See Wu (2003).

[60] See Borreau *et al*. (2006) and Valetti (2006).

[61] See FCC News (2005).

- competition among network providers, application and service providers, and content providers.

This is the clearest description issued to date by a prominent regulatory agency about the shape of things to come under convergence. It places end users in charge of their destiny by being able to take full advantage of the "dumb network, smart end user device" configuration and the competition that exists (or develops) among network providers, application/service providers, and content providers. In terms of the vertically layered policy model, it is as if each of the four complementary layers experiences competition to serve the end user and adds another degree of freedom to the end user's choice problem (which content provider should be the source of content? which application/service provider should be the purveyor of content and services? which network provider shall carry content and services to the end user?) In this scheme of things, the last mile bottleneck is not a matter of policy concern, and there is no call for a mandatory open access requirement at the network level, i.e., the physical layer. But, if network access by the end user or, more importantly, access to the end user through the host network is not a problem, then what about the openness within and between the other layers? In other words, how open can, or should, the Internet be?

It is proving difficult to build consensus around any of these questions. As the debate progresses and positions harden, two facets of the network neutrality question stand out. First, at the very heart of the matter is the current reality: are end users really at the mercy of a duopolistic broadband market structure (as network neutrality proponents contend) or is intermodal competition strong enough to put end users in the driver's seat (as network neutrality opponents contend)?[62] Clearly, the more the world under convergence looks like the latter view of the market, the less would be the need to impose the network neutrality requirement on network providers.

Second, are efficiency and investment incentives better preserved in a network neutrality regime or in its absence? Is retaining open access and non-discrimination requirements better or worse for those incentives? Answers to these questions are necessarily tied to the state of platform competition and end user choice. When platform competition occurs vigorously and end users have real-time choice of both content/service and network provider, the open access and non-discrimination requirements become redundant and, more importantly, antithetical to dynamic efficiency.

Understandably, these questions about network neutrality persist today because the affected parties disagree on the central fact-based issue—how much convergence has occurred so far? However, if some of the recent lobbying and jousting on the issue before the U.S. Congress are any indication, those parties may be less interested in determining whether there is objective economic merit to network neutrality under current circumstances and more interested in the advantages they can secure or lock in through the legislative (i.e., policymaking) process rather than through marketplace tests.[63]

[62] For an example of the latter view, see Dixon (2006) and McSlarrow (2006).

[63] Incumbent telecommunications carriers in the U.S. are embarking on an ambitious build-out of all-fiber networks that can provide, among other things, IPTV and related high-bandwidth services in competition with cable companies. Content providers would like to provide streaming video (movies) in competition with the IPTV offerings of both types of network providers. The difference is that while IPTV services would reach end users over the private IP networks of those network providers, the streaming video services offered by content providers would have to traverse the public Internet and the last mile networks of the network providers. Content providers are concerned that the network providers can discriminate in favor of their own

4.3 Video Franchising

Alongside network neutrality, telecommunications carriers and cable companies in the U.S. are also embroiled in a serious policy debate—opposing each other in this case—on the issue of local video franchising for telecommunications carriers that wish to offer video services. To understand the genesis of this debate, it is necessary to first review the history of cable television in the U.S. and cable franchising, in particular.

4.3.1 The historical context

Historically, TV signals used to be broadcast over the air using antennas installed on hilltops. However, cable systems had to be installed to carry TV signals to end users located in valleys and other places that were not in the "line of sight" between antennas. These cable companies became carriers of last resort and, typically, only operated a few channels to minimize network costs. Initially, the FCC refrained from regulating cable companies as their function and service offerings were limited, and they did not have many customers. However, as they began to transmit TV signals over longer distances and their popularity grew rapidly, cable companies emerged as a competitive threat to traditional TV over-the-air broadcasters.

Over-the-air broadcasting started out as monopoly franchises with regulator-imposed carrier build-out and content obligations. In 1962, when cable TV became a serious competitive alternative to over-the-air broadcasting, the FCC began to address concerns about a level playing field by regulating cable companies. In 1972, after trying out various regulatory measures, the FCC introduced regulation requiring cable companies to carry broadcast signals from local stations, restricting their ability to import signals, and requiring that channels be set aside for public, educational, and government access. While some of these federal regulatory measures were subsequently lifted, cable companies remained subject to franchising by local municipal authorities. Under franchising, those local authorities could require a cable company to pay franchise fees (up to 5 percent of its gross revenues from "cable service").[64] In addition, the federal Cable Act gave municipal authorities the right to require that cable companies set aside channels for public, educational, and government access. In 1992, amendments to the Cable Act gave municipalities further authority to impose customer service and consumer protection requirements on cable companies. Although the amended Cable Act does not allow municipalities to regulate specific cable programming (content), they still have latitude to impose community standards on broad categories of programs and services and require that some programs be provided on designated channels. Typically, municipal local franchise agreements with cable companies tend to be long-term contracts, often covering a period of 7–10 years.

IPTV services (e.g., by not guaranteeing the same quality of service for the streaming video as for the IPTV services). To them, network neutrality is the policy that can prevent what they perceive to be discrimination by the network providers. The network providers counter that if the content providers want guaranteed quality of service equal to that for IPTV services, they should consider paying for private IP-based services like Virtual Private Networks. The network providers vehemently deny any intent to discriminate in favor of their own services, and assert that the call for network neutrality "is based on widespread misinformation and confusion over the difference between the public Internet and private IP-based services…" See Wilson (2006).

[64] Controversial questions surround this 5 percent fee. Is Internet access a cable service? Should capital costs and operating costs both be subject to credit against the 5 percent fee? and so on.

Until recently, telecommunications carriers were prohibited from offering cable service in their telephone franchise areas. The economic justification for this move was at least two-fold. First, policymakers believed that cable companies were natural monopolies, making any competition inefficient and, hence, undesirable. Second, policymakers feared that telecommunications carriers would cross-subsidize their competing video services with revenue from their voice telephone monopolies. Thus, the rationale for keeping telecommunications carriers out of the video market was based at least in part on policymakers' desire to maintain what they believed were natural monopolies. In other words, policymakers elected to achieve a market structure based on allocative efficiency, rather than dynamic efficiency.

Barriers to entry by telecommunications carriers into the video market were lifted in 1996. Those carriers may now offer video services in their operating areas provided that they first obtain municipal franchises. In practical terms, this means that those carriers have to maneuver through a complex application process, which involves public hearings, lobbying efforts, franchise agreement negotiations, city council or county board approval, additional hearings on the negotiated franchise agreement, adoption of the final agreement by the local government, and the payment of filing and acceptance fees. This process has to be repeated in each of the approximately 33,000 counties and municipalities that currently issue cable franchises. Additionally, many cable companies challenge those applications in court, placing financial burdens on the telecommunications carriers that effectively delay their entry into the video market. Consequently, video market entry by telecommunications carriers is rather limited to date. Estimates are that, as of mid-2005, only 4 percent of U.S. homes had a choice of providers for video services.

4.3.2 Cable companies vs. telecommunications carriers

Given the anticipated benefits from telecommunications carriers offering video services at reduced prices and through bundled or expanded service offerings, it is not surprising that the cable companies insist on applying to the telecommunications carriers the same local franchise requirements that apply to them. The telecommunications carriers are responding, in turn, with the demand that national or regional, but not local, franchising requirements should apply to them Some telecommunications carriers are demanding that franchising requirements be abolished altogether. The U.S. Congress is presently considering legislation that would either institute national franchising for telecommunications carriers that offer video services or eliminate the franchising requirements entirely for telecommunications carriers and competitors for those services.

Cable companies oppose national franchise rules for telecommunications carriers, arguing that they are more favorable than the local rules that apply to them and would diminish their ability to compete fairly. Instead, they argue, local video franchise requirements for telecommunications carriers are not a barrier to entry, and it takes as little as 17 days to acquire a franchise. Further, the cable companies claim that they have not had exclusive franchises since 1992, and that they face competition from satellite providers, such as DirecTV and EchoStar, as well as companies like RCN, Knology, and WideOpenWest. In light of this, the cable companies argue, significant video service competition already exists, and claims that entry by telecommunications carriers would reduce prices are nothing but a myth.

4.3.3 The efficiency-based policy choice: abolition of video franchising

The trend towards convergence has made it imperative that telecommunications carriers offer video service as part of their triple play strategy. Indeed, entry by telecommunications carriers into video offerings broadens the relevant market to include all voice, data, and video services, i.e., competition no longer occurs for one or the other service in isolation. In these circumstances, the telecommunications carriers have felt the need to install more bandwidth capacity by upgrading parts of their copper networks with fiber or even installing overlay all-fiber networks. Specifically, the video offerings of the telecommunications carriers (including IPTV) now represent feasible economic substitutes for cable TV. Given these developments, should the proper policy be to impose rules on telecommunications carriers that are justified by appealing to considerations of allocative efficiency alone, or are there other factors in play?

If neither cable companies nor telecommunications carriers today are natural monopolies, then the historical basis for local video franchising obligations no longer exists. Indeed, if dynamic, rather than allocative, efficiency should be the governing principle for policy in the market for triple play services—no longer for just voice or video services— then the correct policy should be to encourage competition among cable companies and telecommunications carriers (and other purveyors of triple play services as well) by removing entry or operational restraints like video franchising requirements. This move will further strengthen inter-platform competition, benefit end users through lower prices and greater service variety, and optimize the allocation of resources in the provision of services over time. Furthermore, as convergence moves more control into the hands of end users and the devices they attach to the network, the traditional extra-economic reasons for local video franchising (such as the provision of separate channels for public, educational, and government use or community control over video content) will eventually disappear. This will prompt the lifting of *all* video franchising regulations, and make the current debate about the franchising rules that should apply to telecommunications carriers moot.

References

[1] Baumol, William J., John C. Panzar, and Robert D. Willig, *Contestable Markets and the Theory of Industry Structure*, revised edition, New York: Harcourt Brace Jovanovich, 1988.

[2] Berg, Sanford V., and John Tschirhart, *Natural Monopoly Regulation*, New York: Cambridge University Press, 1988, pp. 85-91.

[3] Bohlin, Erik, Karolina Brodin, Anders Lundgren, and Bertil Thorngren (eds.), *Convergence in Communications and Beyond*, Amsterdam: Elsevier Science B.V., 2000.

[4] Bohlin, Erik, Stanford L. Levin, Nakil Sung, and Chang-Ho Yoon (eds.), *Global Economy and Digital Society*, Amsterdam: Elsevier Science B.V., 2004.

[5] Borreau, Marc, and Nathalie Sonnac (eds)., "Competition in Two-Sided Markets: Application to Information and Communication Industries," *Communications & Strategies* (special edition), 61, 2006.

[6] Borreau, Marc, David Sevy, and Nathalie Sonnac, "Interview with David Evans" in Borreau and Sonnac (2006) [5].

[7] Carlton, Dennis W., and Jeffrey M. Perloff, *Modern Industrial Organization*, 3rd Edition, New York: Addison-Wesley, 2000, p. 610.

[8] Cave, Martin E., Sumit K. Majumdar, and Ingo Vogelsang (eds.), *Handbook of Telecommunications Economics*, Volume 1, Amsterdam: Elsevier Science B.V., 2000.

[9] Cawley, Richard A., "The Impact of Internet on Communications Regulatory Models in Europe," in Bohlin *et al.*, 2000 [3].

[10] Cerf, Vinton G., Prepared Statement before the U.S. Senate Committee on Commerce, Science, and Transportation, Hearing on "Network Neutrality," February 7, 2006.

[11] Crandall, Robert W., "Telecommunications Liberalization: The U.S. Model," in Takatoshi Ito and Anne O. Krueger (eds.), *Deregulation and Interdependence in the Asia-Pacific Region*, NBER-EASE Volume 8, University of Chicago Press, 2000.

[12] Crandall, Robert W., Allan Ingraham, and Hal Singer, "Do Unbundling Policies Discourage CLEC Facilities-Based Investment?" *Topics in Economic Analysis and Policy*, 4, 2004.

[13] Dixon, Kyle D., Testimony before the U.S. Senate Committee on Commerce, Science, and Transportation, Hearing on "Network Neutrality," February 7, 2006.

[14] European Commission, *Green Paper on the Convergence of Telecommunications, Media and Information Technology Sectors, and the Implications for Regulation*, December 3, 1997, available at http://europa.eu.int/ISPO/convergencegp/97623en.pdf.

[15] European Commission's Framework Directive and the earlier Directive 98/48/EC.

[16] European Commission, "Commission Guidelines on Market Analysis and the Assessment of Significant Market Power under the Community Regulatory Framework for Electronic Communications Networks and Services," 2002/C 165/03, July 11, 2002.

[17] Economides, Nicholas, "US Telecommunications Today," in Carol V. Brown and Heikki Topi (eds.), *IS Management Handbook*, 8th Edition, Boca Raton, FL: Auerbach Publications, 2003.

[18] Economides, Nicholas, "The Economics of the Internet Backbone," in Majumdar *et al.*, 2005 [40].

[19] Eisner, James, and Dale Lehman, "Regulatory Behavior and Competitive Entry," paper presented at the 14th Annual Western Conference, Center for Research in Regulated Industries, Rutgers University, June 28, 2001.

[20] Evans, David S., "Some Empirical Aspects of Multi-Sided Platform Industries," *Review of Network Economics*, 2, 2003, pp. 191-209.

[21] FCC, *Connecting the Globe: A Regulator's Guide to Building a Global Information Community* (Glossary of Frequently Used Telecommunications Terms), June 1999, available at http://www.fcc.gov/connectglobe/glossary.html.

[22] FCC, In the Matter of Review of the Commission's Rules Regarding the Pricing of Unbundled Network Elements and the Resale of Service by Incumbent Local Exchange Carriers, WC Docket No. 03-173, *Notice of Proposed Rulemaking*, released September 15, 2003, especially ¶¶49-54.

[23] FCC, In the Matter of Unbundled Access to Network Elements (WC Docket No. 04-313) and Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers (CC Docket No. 01-338), *Order on Remand*, released February 4, 2005, ¶199.

[24] FCC News, "FCC Adopts Policy Statement: New Principles Preserve and Promote the Open and Interconnected Nature of Public Internet," August 5, 2005.

[25] Fransman, Martin, "Convergence, the Internet and Multimedia: Implications for the Evolution of Industries and Technologies," in Bohlin *et al*., 2000 [3].

[26] Frieden, Rob, "Adjusting the Horizontal and Vertical in Telecommunications Regulation: A Comparison of the Traditional and a New Layered Approach," *Federal Communications Law Journal*, 55, 2003, pp. 207-250.

[27] Geradin, Damien, and J. Gregory Sidak, "European and American Approaches to Antitrust Remedies and the Institutional Design of Regulation in Telecommunications," in Majumdar *et al*., 2005 [40].

[28] Gupta, Alok, Dale O. Stahl, and Andrew B. Whinston, "Pricing Traffic on Interconnected Networks: Issues, Approaches, and Solutions," in Majumdar *et al*., 2005 [40].

[29] Han, Sang-Pil, Jae-Hyeon Ahn, and Ann Skudlark, "Convergence Phenomenon and New Service Development in the Telecommunications Industry," in Bohlin *et al*., 2004 [4].

[30] Haring, John, and Jeffrey Rohlfs, "The Disincentives for ILEC Broadband Investment Afforded by Unbundling Requirements," Strategic Policy Research paper, July 16, 2002.

[31] Haring, John, Margaret Rettle, Jeffrey Rohlfs, and Harry Shooshan III, "UNE Prices and Telecommunications Investment," Strategic Policy Research paper, July 17, 2002.

[32] Hatfield, Dale N., Bridger M. Mitchell, and Padmanabhan Srinagesh, "Emerging Network Technologies," in Majumdar *et al*., 2005 [40].

[33] Hausman, Jerry A., *Taxation by Telecommunications Regulation: The Economics of the E-rate*, Washington DC: American Enterprise Institute Press, 1998.

[34] Hausman, Jerry A., and J. Gregory Sidak, "A Consumer-Welfare Approach to the Mandatory Unbundling of Telecommunications Networks," *The Yale Law Journal*, 109, 1999, 417-505.

[35] Hazlett, Thomas, Coleman Bazelon, John Rutledge, and Deborah Allan Hewitt, "Sending the Right Signals: Promoting Competition Through Telecommunications Reform," A Report to the U.S. Chamber of Commerce, September 22, 2004.

[36] Henten, Anders, Rohan Samarajiva, and William Melody, "Designing Next Generation Telecom Regulation: ICT Convergence or Multisector Utility?" Report on the WDR Dialogue Theme 2002, January 2003.

[37] Jorde, Thomas, J. Gregory Sidak, and David Teece, "Innovation, Investment, and Unbundling," *Yale Journal on Regulation*, 17, 2000, 1-19.

[38] Latzer, Michael, "Toward an Integrated Universal Services Policy for the 'Mediamatics' Sector," in Bohlin *et al.*, 2000 [3].

[39] Lemley, Mark A., and Lawrence Lessig, "The End of End-to-End: Preserving the Architecture of the Internet in the Broadband Era," *University of California Los Angeles Law Review*, 48, 2001, pp. 925-972.

[40] Majumdar, Sumit K., Ingo Vogelsang, and Martin E. Cave (eds.), *Handbook of Telecommunications Economics*, Volume 2, Amsterdam: Elsevier Science B.V., 2005.

[41] McClelland, Stephen, "21 CN: Japan's 21st Century Network (Part 1), *Telecommunications Online*, March 24, 2006. Available at http://www.telecommagazine.com/article.asp?HH_ID=AR_1889.

[42] McSlarrow, Kyle, Testimony before the U.S. Senate Committee on Commerce, Science, and Transportation, Hearing on "Network Neutrality," February 7, 2006.

[43] New Millennium Research Council, "Free Ride: Deficiencies of the MCI 'Layers' Policy Model and the Need for Principles that Encourage Competition in the New IP World," Washington DC, July 2004.

[44] Pindyck, Robert S., "Unbundling and Irreversible Investment in Telecom Networks," National Bureau of Economic Research Working Paper w10287, February 2004.

[45] Riordan, Michael H., "Universal Residential Telephone Service," in Cave *et al.*, 2000 [8].

[46] Rohlfs, Jeffrey H., "Bandwagon Effects in Telecommunications," in Majumdar *et al.*, 2005 [40].

[47] Saltzer, Jerome H., David P. Reed, and David D. Clark, "End-to-End Arguments in System Design," *ACM Transactions in Computer Systems*, 2, 1984, pp. 277-288.

[48] Sappington, David E.M., "Price Regulation," in Cave *et al.*, 2000 [8].

[49] Schement, Jorge Reina, and Scott C. Forbes, "Universal Service in the Information Age," in Gary Madden (ed.), *Emerging Telecommunications Networks: The International Handbook of Telecommunications Economics*, Volume II, Northampton, MA: Edward Elgar, 2003.

[50] Sicker, Douglas C., "Further Defining a Layered Model for Telecommunications Policy," available at http://www.si.umich.edu/tprc/papers/2002/95/TPRC_Layered_model.pdf#search='sicker%20mindel%20Telecommunications%20Policy'.

[51] Sidak, J. Gregory, Testimony before the U.S. Senate Committee on Commerce, Science, and Transportation, Hearing on "Network Neutrality," February 7, 2006.

[52] Train, Kenneth, *Optimal Regulation: The Economic Theory of Natural Monopoly*, Cambridge, MA: The MIT Press, 1991.

[53] Valetti, Tommaso, "Mobile Call Termination: A Tale of Two-Sided Markets," in Borreau and Sonnac, 2006 [5].

[54] Werbach, Kevin, "A Layered Model for Internet Policy," *Telecommunications and High Technology Law*, 1, 2002, pp. 37-67.

[55] Whitt, Richard S., "A Horizontal Leap Forward: Formulating a New Public Policy Framework Based on the Network Layers Model," MCI Public Policy Paper, March 2004.

[56] Wilson, Carol, "TELECOMNEXT: Net Neutrality a Bogus Debate," *Telephony Online*, March 22, 2006.

[57] Wu, Tim, "Network Neutrality, Broadband Discrimination," *Journal of Telecommunications and High Technology Law*, 2, 2003, pp. 141-179.

[58] Wu, Tim, and Lawrence Lessig, Letter to the FCC, *ex parte* submission in CS Docket No. 02-52, August 22, 2003.

[59] Yoo, Christopher S., "Would Mandating Broadband Network Neutrality Help or Hurt Competition? A Comment on the End-to-End Debate," *Journal of Telecommunications and High Technology Law*, 3, 2004, pp. 23-68.