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ABSTRACT

The Aspen Institute's Communications and Society Program convened leaders and experts in the telecommunications and related fields to address telecommunications regulation in an IP (Internet Protocols) environment at the 15th annual Aspen Institute Telecommunications Policy Conference (Aspen, Colorado, August 12-16, 2000). The report from this conference and the accompanying paper are presented in this document. Both set forth a number of new approaches to developing telecommunications regulation-approaches that have at their heart a recognition of differences and developments in technology. The report proposes that the paradigm for telecommunications regulation--one currently based on separate silos of regulation among the various transport media--be revised. Detailed in the report are the four layers developed by conference participants: content, application, network, and data link. In order to frame regulatory concerns properly, participants encouraged policymakers to treat different layers differently. By separating telecommunications concepts into layers, policymakers can choose which layers on which to focus, stimulating competition where it is needed and where it is efficient for them to do so. The report suggests several reasons why the time may be right to adopt a Universal Service with Efficiency (USE) program, and presents participant reasoning for framing a USE program as an educational rather than a welfare program. The dialogue regarding these two concerns forms the core of this report. As a follow-up to this conference, the Aspen Institute commissioned University of California, Berkeley, business professor Michael Katz to think through the significance of such a new-layered approach to communications regulation. This paper examines the concept of "de-lamination" or unbundling layers in the telecommunications process for regulatory purposes, pointing out that de-lamination provides another framework from which to consider

competition and market power, ownership issues, and whether regulations in one layer continue to be useful for other layers. (AEF)

Transition to an IP Environment

A Report of the Fifteenth Annual Aspen Institute Conference on Telecommunications Policy

Robert M. Entman, Rapporteur

with

Thoughts on the Implications of Technological Change for Telecommunications Policy

A paper commissioned by the Aspen Institute Communications and Society Program

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Charles M. Firestone
Executive Director
Washington, DC
2001

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Contents

Foreword

It is now common to observe that the Internet turns business models upside down. Although the telecommunications industry has reaped great benefit from the Internet revolution, it has not escaped this new law of business itself. Telecommunications networks, which were created on "switched circuit" architecture, now face the prospect that those circuits will mostly transport packages of bits according to "Internet Protocols" or "IP."

That is, instead of having to force data bits over lines, connected and switched to create communications "circuits" intended for voice, we are beginning to see voice messages sent in digital bits and packages over the Internet. Voice messages, the heart and soul of our plain old telephone system, are becoming simple applications on the Internet. Indeed, the entire telecommunications system could be viewed as a system of stacks or layers. At its most basic is the raw transmission of bits, on top of which are network protocols to route packages of bits, on top of which are applications to make those packages meaningful (such as voice over Internet), and on top of those applications are different forms of content.

However one views the emerging telecommunications system, it is clear that the regulatory system for its governance is based on the older circuit-switching model. What are the consequences of this apparent disconnect? The telecommunications system in the United States is vast, and the ability of Congress to adjust its regulatory system is notoriously slow. There are varying views on the significance of IP as the dominant protocol and whether it should reshape communications regulation. There are many different forms of regulation in the United States of different transmission modes, and there are strong positions on the speed with which change in the regulatory process should evolve.

With this background, the Aspen Institute's Communications and Society Program convened leaders and experts in the telecommunications and related fields to address telecommunications regulation in an IP environment. The fifteenth annual Aspen Institute Telecommunications Policy Conference, held

in Aspen, Colorado, August 12-16, 2000, resulted in the following report and accompanying paper. Both set forth a number of new approaches to developing telecommunications regulation—approaches that have at their heart a recognition of differences and developments in technology.

Indeed, the report proposes that the paradigm for telecommunications regulation—one currently based on separate silos of regulation among the various transport media—be revised. Going forward, regulation should look across such media to cross-cutting layers.

Detailed in Robert Entman's report, the four layers developed by participants are content, application, network, and data link. In order to frame regulatory concerns properly, participants encouraged policymakers to treat different layers differently. As an example, Entman states that having a variety of Internet service providers (ISPs) and a few local transport facilities makes more economic sense than the reverse. By separating telecommunications concepts into layers, policymakers can choose which layers on which to focus, stimulating competition where it is needed and where it is efficient for them to do so.

As a follow-up to this conference, the Aspen Institute commissioned University of California, Berkeley business professor Michael Katz to think through the significance of such a new-layered approach to communications regulation. Katz, a former chief economist at the Federal Communications Commission, applies his unusually perceptive analytical skills in the paper, which is included in this volume.

Conference participants arrived at the consensus that now was the time, in terms of markets and technology, to take a new look at the traditionally thorny problem of universal service. However, participants had to first determine their definitions of "universal access" and "universal service" in terms of telecommunications service delivery, and determine the difference between the two.

Universal access was defined as "the opportunity for as many people as possible to obtain the newer telecommunications services that will ultimately be judged a 'necessity.'" Wireline phone service is almost universally available in the United States. Cable, fiber upgrades, and digital subscriber lines (DSL) are increasingly available. Where cable is impractical, satellite and wireless broadband can fill the gap. Participants

agreed that there will be near-universal broadband access within five years, but they also acknowledged that access alone does not achieve important social goals.

Universal service, the accessibility of "affordable, essential service," is an important social goal that *can* be achieved. Participants debated not only what advanced services should be considered essential, but at what point it was economically feasible to introduce subsidies, to whom those subsidies would be available, and how the revenue would be derived. The Universal Service with Efficiency (USE) Program, a participant-developed initiative, addresses the need for a limited subsidy system so that all those who wish to take advantage of advanced telecommunications may do so. In essence, participants agreed that with increasing market penetration of advanced services, these services were fast becoming "basic." In order to avoid a continuing telecommunications divide, it was proper to consider a subsidy to ensure their provision. This subsidy, however, would not be instituted until penetration growth rates had flattened out, and would be targeted solely to those who could not afford the newly-defined essential service. Furthermore, the means-tested subsidies would come from general revenues, not internal cross-subsidies.

The report suggests several reasons why the time may be right, politically and fiscally, to adopt a USE subsidy program now. It also presents participant reasoning for framing a USE program as an educational rather than a welfare program.

The dialogue regarding these two concerns—rethinking the telecommunications process as one of layers that may require more or less regulatory attention, and assuring the provision of advanced telecommunications services through the USE program—form the core of this report. While suggesting that the participants reached complete consensus would be an exaggeration, conference participants did put aside their differences to form these thoughtful and significant new bases for policy analysis.

Acknowledgments

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Finally, I wish to express my appreciation to the Aspen Institute Communications and Society Program staff whose work has resulted in this successful conference and report. Thanks to Beth Wachs, program associate, for developing this conference; Patricia Katopol, program associate, for editing the report; Lisa Dauernheim, program coordinator, for coordinating the conference; and Jacqueline Arendse, production editor; and Sunny Sumter-Sana, publications manager, for producing the report.

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February 2001

TRANSITION TO AN IP ENVIRONMENT

Transition to an IP Environment

Introduction

This year's Aspen Institute Conference on Telecommunications Policy began as an attempt to chart a future in which packet-based Voice over Internet Protocol (VoIP) will supplant traditional switched circuit telephony. Among other things, VoIP appears to be propelling the marginal cost of long-distance telephoning toward zero, a development with profound implications for interexchange carriers. However, prompted in part by Lawrence Strickling's specially-commissioned piece, "The Telecommunications Marketplace in 2002: A Somewhat Fanciful Scenario," it did not take long for conference participants to realize that a great deal more than the future profitability of long-distance service is at stake.

Two creative suggestions took hold and sparked the bulk of the discussion in the plenary sessions. First, a near-consensus emerged that now is the most promising time to reform universal service. A confluence of forces has lent a new political feasibility to the long-cherished idea (at least among policy analysts) of drawing universal service subsidies from general revenue funds and targeting them to users in real need. Therefore, participants are urging an immediate attempt to build a broad-based coalition to seize this unusual moment and place a proposal for revamped universal service funding and spending on the agenda for urgent action by the new Congress and administration. Second, dialogue at the conference made it clear that conceptually distinguishing the technical layers of the system offers a new paradigm that can clarify regulatory problems and point to their solutions. Engineers typically think about the communication system as divided into as many as nine layers, each with distinctive properties. For the purposes of public policy, it might suffice to distinguish four (see Table 1).

TABLE 1: FOUR LAYERS OF TELECOMMUNICATIONS

Layer	Examples
Content	A. Conversation (via application A below) B. E-commerce transaction (via application B below) C. CNN video stream (via application C below)
Application	A. Voice B. Authenticated/encrypted connection C. Video
Network	Routing protocols and packet structure
Data Link (interconnection point)	Fiber and copper Coaxial cable Wireless

Thus the data link layer can take a variety of physical forms, as can the network (though by assumption we are moving toward dominance of packet switching). The application layer describes the nature of the service provided, whereas the content layer describes the actual information transmitted—so a standard telephone call consists of a voice application delivering a conversation, an authenticated connection provides the content of an e-commerce transaction, and so forth.[1]

The power of making these distinctions lies in the insights it generates about public policy toward telecommunications. In particular, it suggests such points as:

1. Applications should be separated conceptually from transport and from content.

2. Higher degrees of competition may be more feasible and desirable at some layers than others. Therefore, policymakers should

recognize that a pro-competitive policy may need to treat different layers differently. Encouraging robust competition at, say, the application level, may yield more consumer benefits and economic efficiencies (at least in the short term) than trying to stimulate multiple competitive transport networks. Given economies of scale, it might make more sense to have many Internet service providers (ISPs) using a few local transport facilities than a handful of ISPs using a plethora of competing networks.

3. This means that policymakers can choose their battles more selectively, targeting those points in the layers where promoting competitiveness will yield the most efficient "bang for the buck."

Background

Before returning to the detailed reasoning for the two proposals referring to universal service and distinguishing technical layers, let us step back to consider the analysis that helped the participants arrive at those conclusions. Charles Firestone, executive director of the Aspen Institute's Communications and Society Program, assigned the group the task of developing a typology that would roughly characterize four potential scenarios for the future of the telecommunications system. The potential futures are depicted in a four-fold table that the group developed (see Table 2). On the horizontal axis is a continuum from concentrated, non-competitive markets on the left to highly competitive, non-concentrated markets at the right. The vertical continuum runs from rapid deployment of new technologies that enable converging, cross-platform services (say, a facility that began as a cable TV system providing telephony, or cellular telephone companies delivering broadband Internet) at the top, to slow deployment (companies staying within their traditional "silos") at the bottom.

This schema yields four roughly distinguishable scenarios that the group nicknamed as follows:

- At the upper left quadrant is the "Seven (or Fewer) Samurai" scenario, in which a few large providers rapidly deploy innova-

tive technology that leads to technical convergence and cross-platform offerings. This scenario was the consensus choice as the most likely to occur.

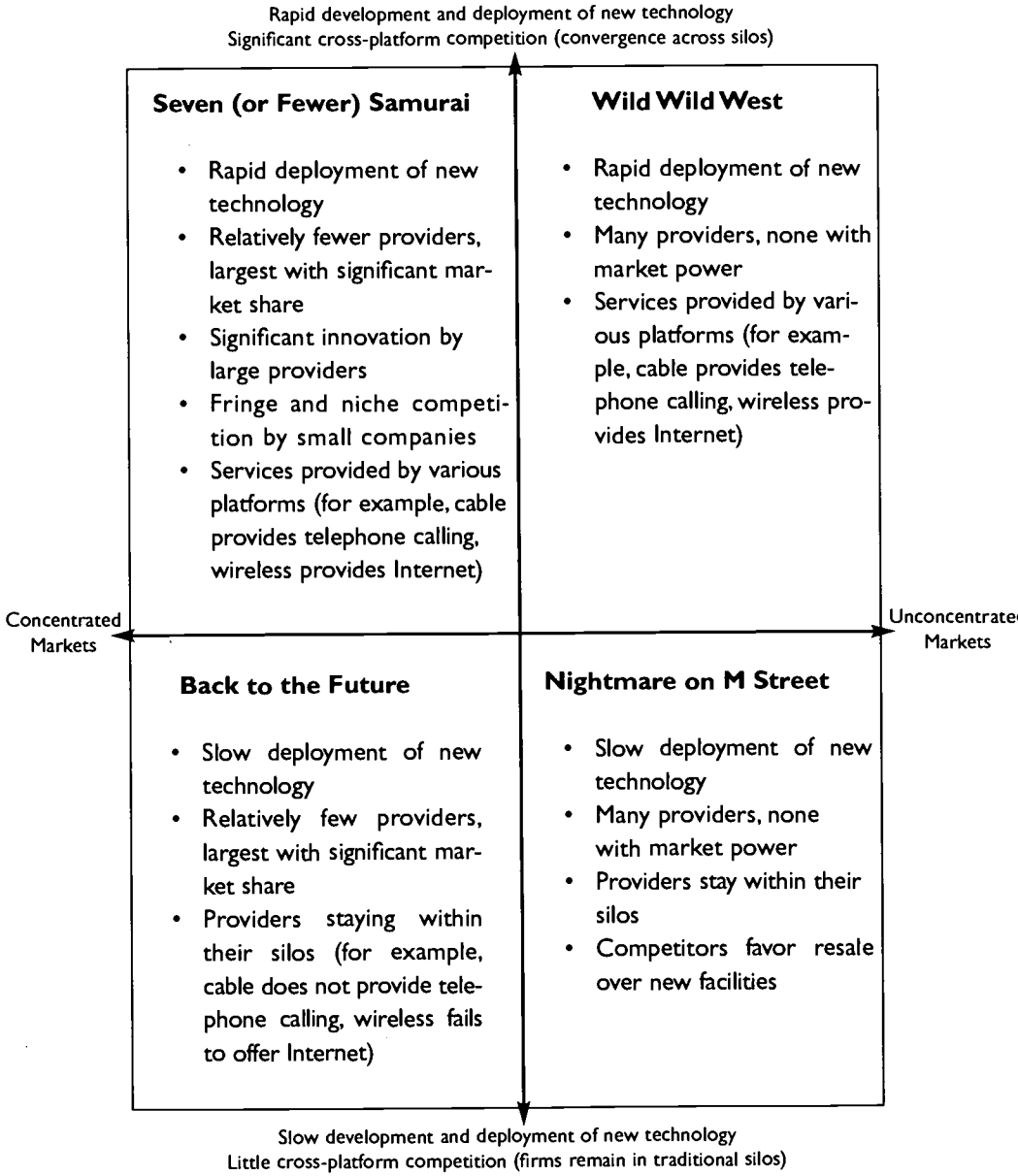
- The upper right quadrant, the "Wild Wild West," features rapid technological deployment by numerous firms in a more fragmented, highly competitive market featuring different technological platforms shooting it out over customers for their products. Generally speaking, with some notable exceptions, participants saw this scenario as suggesting ideals toward which to strive.

- The lower right quadrant, "Nightmare on M Street," projects a future of slowly deployed technologies by numerous, rather weak competitors, each of which offers its own specialized service, with little in the way of cross-platform competition. This scenario would be a "nightmare" in that consumers would see little convergence of technology and few new services, and stockholders would see low returns.

- The lower left quadrant, "Back to the Future," envisions slow deployment of new technology by a handful of providers staying within their "silos" of service. Participants saw this scenario as a rough approximation and extrapolation of today's world.

Many at the conference identified a point near the top of the vertical continuum and the midpoint of the horizontal axis, between Seven Samurai and Wild Wild West, as the best feasible outcome. This point would offer enough providers to maintain innovation, competitive pricing, and efficiency but not so many as to cause a constantly churning "creative destruction" of firms, an instability that might disrupt investment flows and consumer choices. Call this desired ideal point of reference the "Kentucky Derby" scenario: a competitive contest between a dozen or more highly trained, efficient contestants, following well-known, relatively easily enforced rules, on a playing field that is equal and open to all who meet the qualifications. The animating question for the conference then became: What should public policymakers do to

TABLE 2. SCENARIOS: TELECOMMUNICATIONS MARKETS, 2005



nudge the future in the direction of this compromise between oligopolistic competition (Seven Samurai) and unbridled, perhaps unstable, competition (Wild Wild West)?

Although participants made a variety of illuminating points and offered no dearth of creative policy suggestions for achieving a Kentucky Derby scenario, the energies of the group focused most intently on the two aspects already mentioned. First, most participants concluded that universal service reform is both a necessary condition and—at long last—a politically feasible one for reaching the desired optimum level of innovation and efficiency. Second, they found the use of the four-layer (data link, network, application, and content) framework an invaluable tool for crafting more calibrated pro-competition policies. Deliberations on these matters proceeded in smaller working groups that considered specific implications of the four scenarios. The working groups reported to plenary sessions; this report concentrates on the outcomes of the plenaries.

Toward the Universal Service with Efficiency (USE) Program

The working group charged with developing policy to protect users grappled first with the distinction between universal access and universal service. Universal access was deemed the opportunity for as many people as possible to obtain the newer telecommunications services that will ultimately be judged a "necessity." Inter alia, participants considered this idea to mean access to broadband/advanced services (the two terms are used interchangeably here). According to industry sources, access to multichannel video is already available via cable to more than 90 percent of households, and direct satellite to the rest. Wireline telephone, of course, is already available almost everywhere. Currently 70 percent of the cable plant has been upgraded with fiber, and by the end of 2000, broadband cable modem service should be available to 50 percent of cable households. Wireline telephone plant is being upgraded to deliver broadband digital subscriber line (DSL) service in many areas. Satellite and wireless broadband could, within this decade, help deliver access in some areas where cable does not or cannot reach. Direct broadcast satellite with telephone lines used as the upstream link, cur-

rently available almost everywhere, may be sufficient to satisfy the goal of universal access to broadband, and new satellite technology may enable broadband upstream as well. In addition, wideband or broadband transmission (two megabit/second) is likely to be available via terrestrial wireless technologies by 2005, though it may not be as robust and reliable as wireline technology. Spectrum limitations may pose a constraint on the ability of wireless broadband to achieve full equivalence with wireline forms of broadband.

Access to wireless (mobile or fixed) voice telephony is not now considered a component of universal access/service goals. But in the future it could become part of a "necessity" bundle that is subject to universal service programs.

For the bulk of the population, then, access to advanced services by 2005 will be near universal, with cable and/or DSL available to more than 90 percent of households, and satellite and wireless available to fill in most gaps. Under the Seven Samurai scenario, broadband may be less widely available than under the Wild Wild West scenario, which would offer a greater number of competitive suppliers.

However, universal access to broadband is not enough to achieve all of the important social goals, in particular avoiding a "digital divide." Universal service, meaning accessibility by nearly all households to *affordable, essential service* (as has been achieved in wireline telephone), is a desirable goal. The two questions become:

1. Exactly what "service" do we seek to make universally affordable?
2. Can we provide a targeted, general revenue subsidy (not a subsidy drawn from telecommunication prices) to reach this goal?

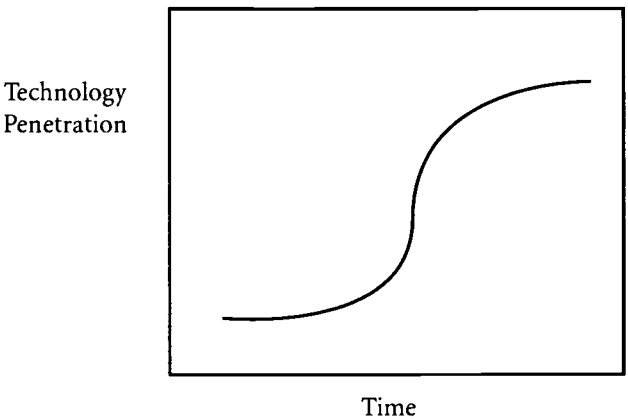
The first question stimulated a far-ranging discussion about exactly what the "bundle" or "bundles" of services envisioned in the Seven Samurai and Wild Wild West scenarios will look like and how to assess them against the goal of making essential service affordable to all. For example, we expect that distinctions within the bundle between long-distance and local voice services will dissolve by 2005—unless regulatory decisions require otherwise. (The group opposed allowing regulation to artificially maintain such distinctions.) Eventually, though perhaps

not by 2005, distinctions between multichannel video services and high-speed broadband Internet services will probably dissolve as well, even though for now most people still want to use a television set for video and a PC or terminal for the Internet. Ultimately the very notion of separate services being "bundled" will probably dissolve, but in wholly unpredictable ways. Thus we cannot really know what the "bundle" or the integrated voice/video/Internet services envisioned in the scenarios will look like and what components will be deemed essential—or even whether it will make sense to conceptualize the service as divisible into components.

One suggestion was to assume that current universal service policy essentially guarantees most households affordable access to telephone lines enabling 28 kilobit per second (28 kbs) service. We might then conceptualize the future "essential service" as, say, affordable access to 1 Megabit per second (Mbs) broadband transmission capacity—that is, a connection with a broadband transport provider—irrespective of the particular applications or content offered. However, the group was reluctant to make a definitive recommendation this far in advance. In general, granting the scenarios, we foresee the dominant situation by 2005 as high-speed, two-way, Internet Protocol (IP)-based, cross-platform—or, assuming convergence, perhaps "integrated platform"—services with three or more competitors. We envision that what today we might consider "cross-platform" service (such as a cable TV system offering telephone calling) will become a series of individual, integrated digital transport platforms providing many, many possible applications. At some point, if a large portion of households subscribe, this new integrated digital platform capability may be deemed essential. If so, subsidies may be needed.

Exactly when a subsidy regime would come into effect depends on the S curve of diffusion of the new service. The slope of the S curve for innovation is typically nearly flat for the first few years, then reaches a sharply sloped period of very rapid growth in penetration. As long as adoption of the new service is occurring at this rapid rate, subsidies are probably not required, even if the absolute level of penetration has not reached the trigger or target for designation as "essential."

FIGURE 1: DIFFUSION OF NEW SERVICES



Regulation should be avoided as long as penetration is growing rapidly. Only when we reach the top part of the curve, when the S begins to flatten out again and penetration growth rates slow significantly, will it be desirable to initiate the subsidy regime. The group did not want to inadvertently disrupt rapid deployment by beginning a subsidy program prematurely. The S curve may flatten out at 70 percent penetration, or growth rates could slow at 56 percent or 85 percent penetration. It is at some combination of absolute penetration and growth rate that the subsidy program should commence. The 1996 Telecommunications Act sets statutory thresholds for when advanced services have penetrated sufficiently, and we recommend following roughly those standards. Participants believe that only when the requisite percentage of households subscribe to the new platform, and growth rates slow significantly, should a means-tested subsidy from general revenue, targeted to help users who cannot afford the service, be instituted.

There may well be political pressure to institute the subsidy prior to the trigger point, as officials hear complaints about how long it is taking certain geographical areas or user groups to receive affordable access. This political pressure may be irresistible. If so, it is all the more

critical that the subsidy format be designed to minimize disruptions to economic efficiency.

The group fully recognized that most observers assume that a targeted, general-revenue, universal-service subsidy is politically infeasible. However, as plenary discussion continued, more and more attendees appeared willing to contest this self-defeating assumption. They did so on several grounds that together add up to a newly convincing case for the political feasibility of a Universal Service with Efficiency (USE) program.

Under either scenario, Seven Samurai or Wild Wild West, we will see cable and telephone firms, and perhaps others, competing to offer the new, integrated digital platforms. With respect to advanced services, there will be no real "incumbents" with long-established practices and price structures that are based on inefficient internal cross subsidies. Therefore, there is a far greater probability that these firms will favor a public subsidy—which would represent financial support to bring them more customers. In addition, the subsidy would provide positive network externality benefits to all (although the size of these benefits has not previously been thought sufficient to motivate strong political support for a USE-type program).

A third basis of political feasibility is the recognition that the conventional wisdom that political forces align against subsidies from general revenue is rooted in the era of large budget deficits. A subsidy to prevent the digital divide—to keep everyone who so desires on the new, advanced, broadband public network, as we kept them on the old, narrowband, public-switched telephone network—could become a popular political cause, one with a strong claim on a portion of the budget surplus. As competition and technology drive prices down, the funding needed to provide such subsidies to those genuinely in need is unlikely to require more than a very small portion of that surplus.

Beyond this picture is the radical change in paradigms that looms before us. As we enter the world envisioned by the scenarios, deciding exactly how to calculate and assess universal service fees on providers (that is, maintaining the current regime of internal subsidies from within the telecommunications market) will become prohibitively complicated, if not impossible. The scenarios envision several providers offer-

ing differing applications and content packages on integrated platforms, some of them by reselling parts of others' facilities. Service integrators, resellers, and other unpredictable genres of provider will arise, all resisting the idea of paying into universal service funds and many legitimately questioning the applicability of any assessment to their particular flavor of application or content. For instance, a spot market in broadband transmission may develop, meaning that a particular applications provider may be employing one network on a given day, another on the next. If each of the network suppliers is assessed different universal service fees, based on which technology they use at the data link layer, figuring out the proper assessment on the applications provider could become nightmarishly complex. As another example, much of the current internal subsidy comes from interstate long distance, a category of application that is becoming increasingly problematic. Carriers will be able to "game" the classification of a transmission to avoid its treatment as interstate traffic and thus avoid paying a universal service assessment. It seems quite possible that the current internal subsidy regime will collapse given inexorable changes at the network and data link layers and alterations in the economic structure of the industry. This potent argument should add political weight to the cause of basing the new regime on targeting end users with subsidies from the general revenue: There may simply be no alternative to ending the old internally-funded universal service regime.

Some attendees continued to express doubt about the feasibility of a USE program. They cited the political problem inherent in providing subsidies to needy end users rather than, as now, carriers. Rural carriers losing lucrative subsidies are likely to complain and may gain sympathetic ears in Congress. On the other hand, the beauty of either the Seven Samurai or the Wild Wild West scenario is that, by assumption, technology and market forces will have brought us to the point that the incremental cost of offering plain old telephone service (POTS) on top of an application bundle that includes video and broadband, is less than the roughly $12 subsidized monthly POTS rate that is so popular politically in rural areas. Under our scenarios, the prototypical, politically powerful "rich guys" in affluent, isolated resort communities, who now

receive subsidized local POTS rates, will migrate to the new application bundle—perhaps paying $80 for a package of multichannel video, broadband internet access, and local plus long distance voice telephony—and therefore will no longer want the low-priced local voice service separately. The need for the old subsidy regime could nearly wither away, especially in light of the fact that even families of limited means often are willing and able to pay $35 per month or more for cable television service alone.

It is true that some, perhaps a large minority of users, may continue to demand inexpensive POTS and nothing more. Politically, this could produce great pressure to maintain subsidized local rates for POTS. The group's sentiment generally was that retaining the subsidies (but taking them from general revenue) is a reasonable and time-limited tradeoff. If everyone can still obtain inexpensive POTS, it will give political cover to the effort to ensure that the new subsidy regime for the advanced platform will be means-tested. The amount of funding needed to maintain inexpensive POTS even for users who can afford to pay more will shrink over time as the advanced applications bundle, including wireline/wireless voice, data/Internet, and video becomes the standard, basic communications service that most households use every day.

The group briefly discussed the matter of technological literacy, agreeing that this goal is as important, and perhaps more difficult to solve than the problem of generating subsidies to keep most people on the new advanced platform network. To the extent that using the new platform and receiving full value from its capabilities will demand more technological savvy than dialing the phone or changing the television channel, it will be important for a broad range of societal institutions to offer training. School and library systems offer information on how to use the Internet, as well as a point of access for the very poorest citizens. Teacher training programs on using new communication and information technology will be critical to ensuring that the E-rate (federal policies providing subsidies for schools and libraries to obtain Internet access) and the proposed new USE programs live up to their potential. This need to educate potential users to the power and opportunities offered by the new advanced applications bundles suggests a final polit-

ical selling point for the USE approach. Rather than framing USE as a welfare-type program, the way past universal service programs have been framed, USE should be regarded as an education program that will help maintain a competitive workforce and citizenry in the twenty-first century.

A Multi-Layered Approach to Regulatory Analysis

As noted in the introduction, beyond the proposal for a genuine push toward reforming universal service, the second breakthrough at the conference arose from conceiving of telecommunications industries as operating at one or more of four layers, data link, network, application, and content. For instance, an application labeled voice communication offers the content "conversation;" for the content of e-commerce transactions, the application is an authenticated and encrypted connection. This perspective enables policymakers to develop a more differentiated understanding of stakes and consequences in regulatory policies. In this case, they would shift their focus, which traditionally is on regulation of the voice application, to regulation of transport. (Among other things, this would keep voice over IP, an application, out of the regulatory scheme.) In terms of our scenarios, the legacy of existing regulatory thinking is likely to keep us, at best, in the Seven Samurai quadrant, and the purpose of thinking in layers is to help move the system toward the Wild Wild West.

The goal of public policy remains efficient prices—that is, moving prices toward cost. In addition, participants emphasized that quality-of-service levels should be set efficiently as well, allowing consumers to choose among alternatives where price differentials reflect cost differentials. Concomitant to these ends would be encouragement of efficiency in innovation, by ensuring a lack of artificial barriers to entry of innovative technologies and services. These are the true policy goals, not competition, which is merely a means to stimulating and directing market forces that help attain the primary goals.

Currently, much pro-competition policy operates at the transport (that is, network or data link) level. Conceptually unbundling application provision from transport provision, combined with an under-

standing that variable levels of competition will arise at different layers, can help guide policymakers toward better policy. As noted previously, for example, many ISPs may compete with each other, providing substantial efficiency benefits even if, because of scale economies, only two or three local transport providers are competing.

Attendees generally agreed that recognizing the distinctions among layers will help achieve optimal levels of competition. Each layer needs to be analyzed separately in terms of bottlenecks that exist or might arise to stymie competition. Each layer has different economies of scale, and economies of scope may arise across layers. To take a hypothetical though not far-fetched example, economies of scale can arise artificially at the application level when the application is tied to other layers. This situation may occur where firms that own cable television systems, operating at the data link and network (transport) layers, also operate vertically integrated content (program) services. This arrangement can constrain the growth of competitive content providers that are not owned by the cable companies, enabling the parent's program suppliers to enjoy economies of scale at the content layer. Furthermore, the parent cable company can benefit from economies of scope. Both economies are to some extent artificial because they rely on the cable company's ability to prevent competitive content providers from having access to transport into the user's home. Moreover, the parent company's control of program services could be used to disadvantage competitive transport firms, such as direct satellite broadcasters, who could have trouble obtaining access to popular program services operated by the cable parent. The goal of public policy in this scenario would be to ensure that independent program providers can have access to network or data link facilities and that all transport providers have access to content suppliers, including those owned by competitive transport companies. The 1996 Telecommunications Act contained provisions to achieve the latter purpose.

An analogy to the cable/programming problem may be the current issue surrounding America Online's Instant Messenger (AIM) service—at the application layer. Officials have suggested that AIM, which operates in the application layer, may have market power because of net-

work effects (the more people use AIM, the more attractive and valuable using that instant messenger service as opposed to another becomes). Yet the reason for AIM's popularity in the first instance may lie in the large subscriber base AOL has as an ISP, not in any superiority of its instant messaging service. Thus federal officials have suggested that AOL be required to open its IM application to other providers of instant messaging as a condition of allowing AOL to merge with Time/Warner (which operates at all four layers). Relatedly, another concern of regulators arises from AT&T's interest in Media One. Through its ownership of the former TCI cable company, AT&T has the largest stake in the Excite@Home cable broadband Internet access company, while Media One's partnership with Time Warner Entertainment gives it a significant share of Road Runner, the only other national cable broadband facility operator. The worry is that with significant or dominant control over both facilities, serving three-fourths of the nation's residential broadband customers, AT&T together with a merged AOL/Time Warner might begin to exert undesirable control over the aggregation, promotion, and distribution of broadband content which is then transported through the broadband facilities. Hence the Department of Justice ordered that AT&T sell Media One's stake in Road Runner as a way of ensuring there would not be a bottleneck for broadband content producers.

Another idea under serious consideration is to require legal guarantees that AOL/Time Warner will open its broadband facilities to competing ISPs. At this writing, the controversy continues over how to handle the possibility that AOL, Time Warner, and AT&T will combine to exert undue control of residential broadband transport and, through that transport, of applications and content.

The conference gave considerable attention to two issues arising from such uses of layers as the core conceptual framework. One is exactly how to implement the insights, how to translate a multi-layered perspective on the industry into effective policy that, where appropriate, treats different layers differently. The second is that once good policies are devised, what enforcement mechanisms can be worked out to minimize delays and gaming of the process—costly problems that have long bedeviled this policy arena.

Regarding exactly what policies should operate, the goal is to move toward efficiencies discussed earlier in this section, to a compromise position between the unbridled, potentially investment-dampening competition of an extreme Wild Wild West scenario and the relatively closed, oligopolistic competition among Seven (or fewer) Samurai. Most participants agreed that ideally, when a provider operates at multiple layers, public policy should keep interfaces open to interconnection at each layer. This premise would mean providing for both horizontal interconnection (that is, openness to connecting with firms that are competing at the same layer), and vertical unbundling (giving competitors access to one layer without demanding that they take access to others). The aim would be to vitiate any anti-competitive advantages that might come from vertical integration.

A policy of open interfaces between layers should mean that competitors would experience them as if they were separately owned layers. Thus, for instance, an ISP that does not possess its own high-speed data links should be able to enter a broadband provider's facility at the data link or network layer. Vertical unbundling facilitates entry, which can occur at a single layer, creating an easier hurdle for newcomers than having to provide end-to-end (or top-to-bottom) facilities. These policies should also prevent the most concentrated layer from driving an increase in overall market concentration. The hope is that a virtuous circle would arise with interconnection stimulating competition and competition augmenting interconnection opportunities.

There are other policy-relevant distinctions within at least the data link layer. The importance of horizontal interconnection arises particularly at those levels within the data link layer at which bottlenecks occur: local access and interoffice transport. On the other hand, backbone transport (long-haul, high-capacity) is generally not a bottleneck, so ensuring interconnection at this point is not as critical. As noted previously, bottlenecks of a sort may also arise at the application layer, from network effects, as arguably in the case of AIM.

But the idea of thinking through layers ran into some skepticism. For one thing, enforcing interconnection at each layer interface would itself pose a heavy regulatory agenda for government. For instance, would

regulators wind up having to regulate interconnection prices? Or might enforcing open interfaces lead to the kind of lengthy proceedings that state and federal regulators (and companies) have had to endure to certify that incumbent local exchange carriers (ILECs) have sufficiently opened access for competitors to the local network (under Section 271 of the 1996 Telecommunications Act)? Moreover, some participants feared that burdensome interconnection requirements could erode earnings and depress incentives to invest in innovative or competitive facilities—both among incumbents forced to share with competitors and, because open access provides a "free ride" (or inexpensive ride) on facilities, even among new entrants.

The most frequent response to the question of where regulation should focus was that it would be limited to bottlenecks because, in the view of more than one participant, bottlenecks will be the exception rather than the rule. We would not need to mandate wholesale-priced access at each layer if we assume that competition gives most firms a natural interest in maximizing use of its facilities. Mobile telephony roaming in Europe offers a precedent. Even without government mandate, cellular companies engage widely in wholesaling to competitors. It is reasonable to expect that companies will decide whether to "outsource" (that is, use others' data links, networks, applications, or content), or to operate at these layers themselves, based mostly on their own business plans. In other words, competition can create conditions wherein government does not need to mandate interconnection because firms find interconnection desirable for business reasons. Only at some problematic interfaces will there perhaps need to be government mandates and oversight.

Beyond this puzzle, some questions were raised about the applicability of the layer conception in the evolving world. The layer model is rooted in the era of landline, circuit-switched telephone networks as the major transmission facilities. If the world develops as the scenarios assume, dominated by converged, two-way, high-speed broadband systems using IP or related packet switching, the ability for regulators or competitors to parse neatly separate layers may diminish. And as always, players will look for loopholes and ways to game the system.

There is, for instance, a danger that incumbents could design architectures deliberately to make it difficult for regulators to impose effective openness requirements at some layers. Perplexities of implementation aside, one important benefit of thinking about regulatory policy in this manner is that it will help to achieve parity among market participants. This way of thinking highlights the disparity that can arise if, say, two firms have identical or substitutable transport networks, yet only the one that happens to offer the voice application faces unbundling, interconnection, or other regulatory requirements. Then the question would arise explicitly whether this disparity is justifiable.

Breaking the Policy Logjam to Promote Interconnection

Visions of regulatory improvement, however creative, typically run into problems regarding process. Companies that are subject to regulation can devise a myriad of ways of pursuing their own short-term interests through whatever barriers policy might place in their way. As it has for the past several years, the Aspen conference heard calls for departures in the ways officials and those subject to their jurisdiction do regulatory business with each other. A working group elaborated several key recommendations and filled in some of the details. The consensus was that government should:

- *Promote competition* to create conditions under which interconnection is privately desirable;
- *Facilitate private negotiations* to encourage interconnection through private contracts;
- *Mandate arbitration* to force private contracting when private negotiations fail;
- *Use non-discrimination and disclosure requirements* to leverage the bargaining power of smaller providers; and
- Where negotiations and arbitration fail to achieve desired ends, *regulate relevant prices, terms, and conditions.*

To spur private parties to act privately to resolve disputes over interconnection or unbundling, government should facilitate open and ongoing face-to-face interaction among a wide range of stakeholders, while retaining the "stick" of regulatory intervention if negotiations ultimately fail. Government action or its potential creates bargaining power for non-dominant providers. Regulators must be able credibly to commit to regulatory action by a date certain (or a well-defined trigger point) after negotiations have been allowed to operate.

Firms discussing interconnection would be encouraged to engage seriously in the face-to-face meetings before resorting to agency pleadings or court action. The meetings should include providers and their customers and should minimize any role for attorneys, instead featuring conversation among technical and business people. The meetings should also include multiple rounds of interaction, on the assumption that one or two exchanges are not enough to build trust and understanding or fully explore alternatives. The resulting interconnection agreements would be embodied as private contracts that would then be enforced through standard commercial dispute resolution mechanisms. At this stage, attorneys would play a critical role. Contracts should include self-enforcement mechanisms (for example, reasonable performance standards, measures, and penalties, including liquidated damages). Where contracts cannot be reached, government could invoke mandatory arbitration rather than regulation. Only in the last instance would regulation come into play, but it would have to be clear from the beginning that the intervention would indeed occur upon the failure of parties to reach a contract or arbitrated settlement.

Beyond this scheme, even within the more traditional regulatory process, new and faster approaches to rulemaking should be promoted and made the typical procedure rather than an exceptional or experimental case. An example is the "Rocket Docket" procedure at the Federal Communications Commission (FCC). This process shortens filing deadlines, streamlines forms, and brings interested parties "to the table" quickly in order to bring about speedy, sometimes informal resolution of regulatory disputes—occasionally "in a matter of days," according to FCC Chair William Kennard.[2] Conference participants felt

that the "Rocket Docket" has been a great success but would like to see it made more widely and routinely available to telecommunications providers that need regulatory decisions. Similar mechanisms have been tried in several states and these mechanisms deserve to be institutionalized and made routinely available in those jurisdictions.

Conclusion

This report focuses narrowly on the creative suggestions possessing not only ingenuity but also political feasibility. Conference participants differed on details but generally exhibited substantial agreement on the desirability of mounting a concerted effort for a program of modernized, efficient, universal service subsidies. They also saw the usefulness of conceptualizing the emerging, likely converging markets in telecommunications as operating in layers that merit differentiated—and innovative—regulatory attention and action. Attendees generally believed that these two efforts would make a significant contribution to halting any tendency for the United States to go "Back to the Future" or to have a "Nightmare on M Street." Instead, these efforts promote a move toward a future of competition, innovation, and efficiency.

Notes

1. See also Kevin Werbach, "A Layered Model for Internet Policy," paper presented at Telecommunications Policy Research Conference, Alexandria, Virginia, September 23-25, 2000.

2. "The FCC's New Enforcement Ethic," presentation at 1999 Annual Meeting, Comptel, Atlanta, Georgia, February 8, 1999.

THOUGHTS ON THE IMPLICATIONS OF TECHNOLOGICAL CHANGE FOR TELECOMMUNICATIONS POLICY

Thoughts on the Implications of Technological Change for Telecommunications Policy

by Michael L. Katz[1]

I. Introduction

Telecommunications networks are undergoing fundamental technological changes. Once voice was carried over circuit-switched networks, video was broadcast over distinct unswitched radio and cable networks, and data traffic was carried over a still different set of packet networks. It now appears that all types of traffic are heading—albeit in some cases slowly—toward carriage on a collection of networks that are based on an updated Internet architecture.

Two features of the Internet architecture are of particular interest. First, the Internet is based on a layering model that specifies how the different logical components that are needed to generate and transport messages interact with one another. One conceptualization of the layers is illustrated in Figure 1.[2] A critical characteristic of Internet layering is that there are minimal specifications of protocols in the middle that support a wide range of transport networks below and a wide range of applications above. The resulting pattern is sometimes referred to as the hourglass structure of the Internet architecture, as illustrated in Figure 2.[3] A second feature of the Internet architecture is that the intelligence resides on the edge of the network. That is, terminal devices (for example, personal computers and personal digital assistants) are relatively intelligent, whereas the cores of the interconnected networks are relatively dumb.[4]

These features of the Internet architecture give rise to two developments that have profound implications for business models and public policy. One development is the advent of "Swiss Army" networks that are capable of providing transport for a wide range of applications. The second, closely related, development is the separation of applications from the underlying transport layer. That is, new applications can be developed that need only comply with the intermediate protocols and

One View of the Layers

Layer	Example
Content	Conversation E-commerce transaction CNN video stream
Application	Voice Authenticated connection Video
Network	Routing protocols and packet structure
Data Link	Fiber and copper

Figure 1

can be oblivious to the details of the underlying transport networks. I refer to this separation of the layers as "de-lamination."[5]

The rise of Swiss Army networks facilitates convergence as networks that previously carried distinct applications can now transport overlapping sets of applications. For example, upgraded cable networks are being used to offer data services and some day may be used to offer voice services on a widespread basis. Telephone networks carry voice services and increasingly data as well. This convergence creates new opportunities for suppliers, as incumbent transport providers can extend their businesses into new markets, and new entrants can offer transport services for many applications at once.

De-lamination also creates new opportunities for businesses and the potential for increased competition. The hourglass architecture allows innovations to take place at the application and transport layers separately. This ability for independent innovation speeds the rate of innovation and increases the ability of entrepreneurs to take advantage of new opportunities. For example, someone with an idea for a new application can bring it to market without having to alter the underlying transport infrastructure. In light of the intelligence of edge devices, the

potential range of innovations is tremendous because the devices can be programmed to support many different services. In contrast, vertical services on the telephone network largely had to be programmed into the core of the network because that is where the intelligence resided.

Hourglass Architecture

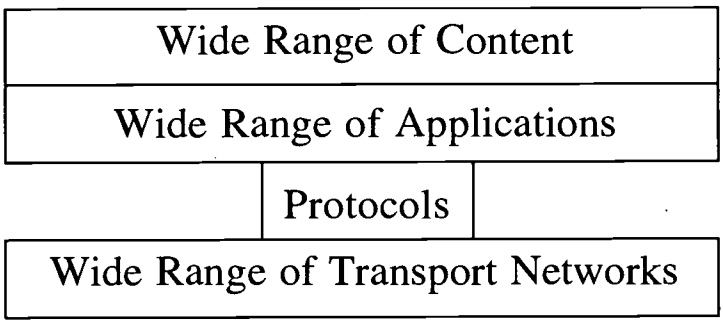


Figure 2

Swiss Army networks and de-lamination also have significant implications for public policy. To the extent that these developments increase competition, there is less need for certain types of regulation that is aimed at preventing the exercise of market power at the retail level.[6] The increase in competition can increase strains on regulation, however. These strains arise because historically regulation created different regimes for different types of companies, where these companies were distinguished by the principal applications transported by their specialized networks. For example, regulation distinguishes telephone carriers from cable companies from broadcasters. Differential regulatory regimes may have been appropriate when the various suppliers operated in separate markets. However, differential regulatory treatment can give rise to distortions and efficiency losses when it is applied to suppliers who actually or potentially compete against one another as the result of convergence. Thus, network convergence dramatically increases the need for regulatory harmonization.

The Fourteenth Annual Aspen Institute Conference on Telecommunications Policy addressed the need for regulatory harmonization.[7] A paper prepared for that seminar identified two broad principles of harmonization.[8] Under *service harmonization*, any two services that users view as close substitutes for one another are subject to similar regulation to avoid distorting competition. Under *medium harmonization*, any two services transmitted over the same transport network are treated equally even if they are otherwise very different. The rationale for medium harmonization is that when regulators cannot easily determine which service is which, providers and users have incentives to engage in *regulatory arbitrage* by labeling traffic according to whatever service receives the most favorable treatment.[9]

The Fourteenth Annual Aspen Institute Conference on Telecommunications Policy focused on the implications of Swiss Army networks for harmonization, but it did not address the implications of de-lamination. In a de-laminated world, one must examine the two types of harmonization layer by layer.[10] The rise of Swiss Army networks creates the need for service harmonization at the transport layer but not the applications layer. The rise of Swiss Army networks also broadens the scope of medium harmonization, which concerns harmonizing the treatment of applications.

The public policy implications of de-lamination run deeper than this. Historically, the application of U.S. telecommunications policy has equated applications (end-user services) with underlying transmission networks. That policy was based, for example, on the notion that a telephone company uses a circuit-switched network to provide telephone services, and a cable company uses a dedicated cable network to offer cable services. The equation was used to distinguish between applications, and it fostered the belief that appropriate regulatory categories were stable over time. As a result of technological changes, however, it is no longer appropriate to equate applications with underlying transport networks.

There are three major implications of this fact. First, de-lamination should be taken into account in assessing market power and determining the appropriate treatment of firms under merger policy, price regulation, and interconnection obligations. As de-lamination continues, it

will become increasingly appropriate to examine and address market power in transport and applications separately.

Second, de-lamination lowers the costs of vertical unbundling and having separately owned providers at different layers. This fact raises the question of whether policy-makers should actively encourage vertical unbundling and ownership separation.

A third major implication of de-lamination follows from the fact that it is increasingly inappropriate to define applications in terms of their underlying transport technology. This trend is important because public policy treatment of a firm often depends on the label attached to the firm or its service. For example, a firm that provides interstate services has to contribute to funding universal service if it provides *telecommunications services*, but not if it provides *information services*. By itself, the fact that definitions matter implies that care should be taken in crafting and applying them. Ongoing technological developments increase the need for care. Market participants can be expected to "game" the regulatory system in rational pursuit of their self-interests, and policymakers should take into account how de-lamination and networks' increased flexibility increase private parties' opportunities to play regulatory name games.

The remainder of this paper addresses these issues and is organized as follows.[11] Section II discusses in more detail the ways in which de-lamination matters for the formulation and implementation of public policy. Section III then examines the implications of de-lamination for the assessment of market power, which is a key first step in the design of many public policies. Section IV examines whether de-lamination increases the net social benefits of public policies that promote vertical ownership separation as well as unbundling, and whether commercial interests threaten the open, layered model. Section V examines universal service as a prominent example of a policy in which regulatory labels play a central role. Section VI examines a somewhat different issue: the use of the Internet as a "clean slate" on which to reform public policy. This issue is relevant because this policy approach essentially ignores de-lamination by basing the regulatory treatment of an application on the underlying transport technology. Section VII concludes with the

hope that the technological changes discussed in this paper will provide the impetus for long overdue changes in regulatory policy.

II. Why De-Lamination Matters for Public Policy

This section assesses in greater depth why ongoing technological developments matter for public policy. It begins by presenting a simple typology of policy intervention, which helps to structure the discussion of the effects of technological change on public policy.

A. A Brief Typology of Public Policy

There are several different forms of public policy intervention in telecommunications markets, as well as rationales for public policy intervention. They include:

- *Intervention to control the creation or exercise of market power.* The treatment of mergers, predation, and exclusion are primary examples of intervention to limit the creation of market power. Regulatory ceilings on the retail prices charged by service providers are a primary example of intervention aimed at limiting the exercise of market power, rather than its creation. Interconnection policy reflects a combination of objectives to promote competition and to limit the exercise of existing market power.

- *Behavioral restrictions to generate market power for other providers.* Regulations sometimes forbid some potential providers from supplying particular services. For instance, for many years local exchange telephone companies were not allowed to provide cable television services, and additional entry into local exchange telephone markets was severely hampered by regulation.

- *Collection of taxes or payments of subsidies.* Many policies entail taxes or subsidies. Here taxation refers to any obligation imposed on a provider that, at least in part, transfers wealth to others.[12] Taxation can be in cash or in kind. Explicit contributions to the universal service fund are an example of direct

monetary taxation. Television broadcasters' obligation to air educational programs aimed at children is an example of an in-kind tax. Similarly, universal support is a monetary subsidy, whereas the spectrum licenses given to over-the-air terrestrial broadcasters are in-kind subsidies.

- *Content prohibitions.* Public policy sometimes restricts content. For example, broadcasters face limitations on the nature of the content they are allowed to offer (for example, limits on indecent and obscene materials). The controversy that has followed attempts to regulate content on the World Wide Web is well known.

The analysis that follows focuses on the implications of de-lamination for policies that limit market power or administer taxes and subsidies. Policies designed to limit competition are ignored here because, in recent years, there has properly been a significant reduction in such policies.[13] Because content prohibitions generally raise very different issues, they are also ignored here, with the exception of the following point: De-lamination raises the question of the appropriate level at which to apply content prohibitions. A quick analysis suggests that content prohibitions should be applied at the applications layer, based on two features of any given application: the ease with which viewers can avoid being exposed to its content and the ability to limit minors' access to this content. Whether the application is transmitted over wires or the airwaves, using circuits or packets, is irrelevant.

B. Policies to Limit the Creation and Exercise of Market Power

For several reasons, failure to recognize de-lamination can lead to incorrect assessment of market power and application of inappropriate policies to limit it. First, it can be very misleading to make the determination of whether two applications compete with one another based on some notion of the similarity of the underlying transmission networks. In the future, a packet-based wireless network and a circuit-switched wireline network might support applications that compete head-to-head with one another. Second, a worldview that equates applications

with underlying transmission technologies will tend to overestimate the barriers to entry and underestimate the emergence of future applications competition. Third, failure to recognize de-lamination may lead policymakers to misdiagnose the source of the market power (for example, the layer at which it occurs) and thus address the wrong problem. Fourth, policies to counter market power may have to be structured to account for layering. For example, interconnection requirements can be applied at different layers, and regulators should analyze the appropriate layers at which to mandate interconnection. Last, de-lamination and the rise of Swiss Army networks facilitates the creation of complex and changing service bundles. Unless policymakers take these increased bundling opportunities into account, they may institute regulations intended to limit the exercise of market power for specific applications that turn out to be unenforceable because it is impossible to disentangle the component prices of the applications bundles.

C. Playing the Regulatory Name Game

Ideally, the public policy treatment of each firm would depend on a complete assessment of the firm's market position, and the treatment would be tailored appropriately to promote social objectives. For large mergers, something approximating this approach is currently taken. Such an approach apparently is too costly to apply in every instance of policy intervention, however.[14] Instead, the regulatory treatment of a firm is often driven by the broad category into which the firm or its services are placed and the label that is attached to them. Consequently, names and definitions do matter.

The best-known current example is the so-called voice-over-IP. The regulation of voice telephony distinguishes between voice service carried over traditional circuit-switched networks and voice service carried over packet networks, using Internet protocols. In particular, a provider offering long-distance voice service "over the Internet" is not subject to interstate access charges, whereas a traditional long distance carrier is.[15]

This distinction raises two sorts of problem. The first problem is that it violates the principle of service harmonization. In doing so, it distorts competition and may lead consumers to make socially inefficient choic-

es. In this regard, it is amusing (or depressing) to note that this sort of problem is nothing new to public policy in communications markets:

> Before the overhaul of the [British] postal system in the mid-1800s, sending a letter cost about a shilling for every hundred miles, beyond the means of most people. However, newspapers could be posted free of charge, and this provided a loophole for thrifty Victorians. Instead of writing and sending letters, people began using pinpricks [placed over individual letters] to spell out a message on the front page of a newspaper.[16]

In a century and half, packets have replaced pinpricks as the means of exploiting well-meaning policies.

A second problem illustrated by the voice-over-IP example is that economic agents may expend resources trying to obtain favorable labels. Federal Communications Commission (FCC or Commission) chairman William Kennard has labeled such investments in lawyers and lobbyists "regulatory capitalism."[17] Although privately valuable, such investments are socially wasteful because they do not add to productive capacity or improve services.

A more ominous problem results when firms take the costs and benefits of particular labels into account when making investment decisions that involve resources whose value is more clearly positive than is the social shadow price of lawyers' time. For example, a firm may distort its investment in network infrastructure in order to qualify as a provider of voice-over-IP services rather than traditional long distance voice service. Again, such investments may be a privately rational response to the regulatory system, but they are socially wasteful to the extent that firms choose less economically appropriate technologies simply to fit into a particular regulatory category.

The concerns are not new, but recent technological developments can make the problems of the regulatory name game much stronger.[18] De-lamination gives suppliers increased power to game the system, particularly where regulation incorrectly equates applications with underlying transport. Because of de-lamination, service innovations can take place much more quickly, including those designed to take advantage of

regulatory definitions and loopholes. The regulatory mess regarding the question of whether Internet Service Providers (ISPs) are entitled to reciprocal compensation provides a good example of how de-lamination and the increased pace of innovation can expose existing flaws in regulatory schemes. Neither Congress nor the FCC has ever offered a fully reasoned justification for the reciprocal compensation regime and the notion that the originating network should pay the terminating network if the call is deemed to be local. When traffic flows were approximately in equilibrium, the lack of a sound economic basis for the policy was masked by the fact that the flows in each direction largely cancelled one another out in terms of the amounts paid.[19] Dial-up ISPs exposed flaws in the system by presenting greatly unbalanced traffic that also pushed the envelope of geographic definition. While distinctions based on call direction and geography have never been well thought out, now the financial consequences are much larger.

The definitions of *telecommunications* and *information services* play especially important roles in regulatory policy as set out by the Telecommunications Act of 1996 (1996 Act), and it is worth examining their appropriateness in a de-laminating world.[20] The 1996 Act states that "[e]very telecommunications carrier that provides interstate telecommunications services shall contribute..." to universal service.[21] The 1996 Act also states that "[e]ach telecommunications carrier has the duty... to interconnect directly or indirectly with the facilities and equipment of other telecommunications carriers..."[22] and the Act imposes obligations on telecommunications carriers with respect to the privacy of subscriber information.[23] Moreover, under *Computer II*, the FCC imposes vertical unbundling requirements on facilities-based common carriers that provide enhanced services in conjunction with basic services, where the enhanced/basic distinction is parallel to the information services/telecommunications services distinction.[24] Hence, the public policy treatment of a service is greatly affected by whether the telecommunications or information services label is attached to it.

The 1996 Act offers the following definitions of these two key terms. The definition of telecommunications service is in two parts, which collectively appear to apply to the transport layer:

> The term "telecommunications" means the transmission, between or among points specified by the user, of information of the user's choosing, without change in the form or content of the information as sent and received.[25]

> The term "telecommunications service" means the offering of telecommunications for a fee directly to the public, or to such classes of users as to be effectively available directly to the public, regardless of the facilities used.[26]

Information services appears to apply to the applications layer:

> The term "information service" means the offering of a capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing, or making available information via telecommunications, and includes electronic publishing, but does not include any use of any such capability for the management, control, or operation of a telecommunications system or the management of a telecommunications service.[27]

It might appear that these definitions already reflect layering and thus are appropriate to a de-laminated world. The Commission's interpretation and application of these definitions, however, clearly do not fit the layered view. Taking these definitions at face value, one is hard pressed to explain how *telecommunications* does not include many of the services offered by ISPs and all of the services offered by Internet backbone service providers. To date, however the FCC generally has found that "the Internet" falls outside of telecommunications.[28] Moreover, the FCC makes distinctions at the applications layer based on the underlying transport layer, notably the differential treatment of voice over traditional networks and voice-over-IP.

One of the questions posed by the FCC in a recent Notice of Inquiry is whether a vertically bundled package of telecommunications and an information service provided over cable facilities should be treated, in part, as a telecommunications service.[29] Manifestly, a policy that did not break out the telecommunications component would fail to recognize

de-lamination and would be subject to gaming and raising the possibility of competitive distortions.

D. Brief Remarks on Jurisdiction

Telecommunications policy in the United States is created and implemented at a variety of jurisdictional levels. Policy toward television, radio, and wireless telephony generally is made at the federal level. The responsibility for wireline telephone regulation is principally split between the federal government and the 50 states and the District of Columbia.[30] Cable networks are subject to regulation at the federal, state, and local levels.

The division of responsibility among jurisdictions is an important and often contentious issue.[31] Many of the distinctions between intrastate and inter-state telecommunications services have always been suspect. Both types of calling were often offered over largely the same facilities and were identical from the point of view of much of the network. The increased pace of innovation resulting from de-lamination and edge-intelligence, and the consequent increase in the ability of firms to enter the industry offering new, uncategorized services will only make these problems worse. Moreover, jurisdictional analysis is very likely to become even more of a mess if policymakers continue to try to determine the "location" of services in the applications layer. It is far from evident that an application is usefully viewed as having a location, and looking at message endpoints becomes extremely difficult when an end user may jump among many geographically diverse sites during a single session, as happens on the World Wide Web.

A possible consequence of these developments is that all layers will increasingly be regulated at the federal level. State or local regulation of services in the applications layer is unlikely to be optimal because applications generally will be available on a national or even international basis. The distribution of an application will be particularly broad when the application is implemented through software that can be electronically distributed to general-purpose edge devices (for example, personal computers equipped with browsers that can serve as terminal devices for any of a wide range of applications for which the appropriate soft-

ware can be downloaded). Even national regulation might eventually be too narrow, although it may be the best available alternative in the absence of broad, effective mechanisms for international cooperation. Turning to the transport layer, one could argue for state or local regulation of local transport based on the location of the facilities and the effects on local access markets, but doing so would require a significant change in the current process for assigning jurisdiction, which at least nominally looks at communications end points.

III. Public Policy toward Market Power

This section examines how de-lamination and related developments affect public policy toward market power. In particular, it examines the assessment of market power, which is a fundamental element of designing policies to limit the inefficient creation or exercise of market power.

A. Implications of De-Lamination

As de-lamination continues, the assessment of market power should largely take place at each layer separately, although one must also examine the effects of any business strategy that entails vertical integration or bundling across layers. Holding aside such vertical strategies for the moment, it is important to recognize that competition occurs at distinct layers and not to confuse competition at different layers. For instance, having a large number of firms providing dial-up ISP services does not create competition in the provision of local transport (access).[32]

At the transport layer, it is useful to focus on "bottleneck assets" or "network choke points" as sources of market power, as long as networks remain interconnected.[33] A bottleneck is created when one or very few providers possess an asset (for example, transport facilities) that is critical to competitive success and cannot readily be obtained by rivals.[34] An important part of the assessment of market power is to understand why rivals cannot readily replicate the assets. In the case of local access networks, economies of density and scale coupled with the sunk-cost nature of network investments have created a system in which incumbents may have preempted additional entry to serve single-family residences. It is conceivable that in the future a transport provider will have

intellectual property rights to a critical technology, but that is not the case today.

The analysis of market power at the applications layer is likely to focus on somewhat different factors. At this layer, the likely sources of market power are intellectual property rights; first-mover advantages resulting from large fixed and sunk development costs; and network effects.[35] Network effects may be a minimal issue if the software needed by an end-user to run an application can be distributed to the user in real time and easily operated, similar to downloading a plug-in to a web browser. Under this scenario, anyone could join an application's network on an as-needed basis, and an installed base would have relatively little importance. But if the software is inconvenient to download and operate on such a basis, network effects may be important.[36]

B. Three Myths and an Analysis

To illustrate these ideas further, it is useful to consider an idealized situation in which various industry trends are taken to their extreme. Specifically, for discussion purposes, assume that the following three myths are true:

- *Swiss Army networks and full de-lamination are a reality.*
- *All digital bit streams look alike.*
- *Transport networks are fully interconnected.*

What would the regulation of voice telephony look like if all three myths were true? If all networks could carry all applications and are fully interconnected, the issue of market power at the transport level would come down to whether any network had specific routes on which it had unique facilities. Given the large number of networks that can reach almost any potential subscriber, generally one would conclude that there was no problem of market power at the transport layer.

Turning to the applications layer, voice service would be defined as an application that allowed the real-time, two-way exchange of voice messages with a quality that consumers find sufficiently comparable to

plain old telephone service that they are willing to substitute one service for another at cost-based prices.[37] The focus at the applications layer would be on whether any provider or providers had market power in the provision of that application, regardless of whether the application ran over a circuit-switched or packet network and whether the network was wired or wireless. Given the hypothesized competition among several Swiss Army networks and the relative simplicity of the voice application itself on such networks, one would expect intense competition in the voice application as long as no firm could create market power for itself by offering an application that would not interoperate with the voice applications of rival providers.

C. Complications from Reality

The preceding analysis made three assumptions that may hold in the future but are unrealistic today. In contrast to the three myths:

- *Swiss Army networks and full de-lamination are not a reality.* All networks are not created equal. The myth that they are is, in part, an outgrowth of the meta-myth that a bit is a bit and that digital networks therefore are inherently Swiss Army networks. The meta-myth fails to recognize that different applications put different demands on the transport of bit streams in terms of latency and the ability to handle dropped bits or packets, for example. We still live in a world of specialized networks. Today, dedicated, circuit-switched voice networks provide higher-quality voice services than do the packet networks that make up the Internet.

- *Digital bit streams look different for different applications.* Another corollary of the meta-myth is that service providers and policy makers cannot distinguish between different applications once they are running over the same packet network. But because different applications place different demands on the network, packets will have to contain information pertaining to quality of service, which will then be subject to observa-

tion, at least to a degree. Important questions are whether policymakers can do so at reasonable cost and whether they will use the information productively. History suggests that the answer to the second question is no.[38]

- *Transport networks are not fully interconnected.* In fact, there are varying degrees and qualities of interconnection, even among Internet backbones. Moreover, networks may attempt to differentiate themselves by offering proprietary transport features beyond those that are supported by common protocols.

How does one analyze competition when various networks can serve as the transport layer for some services but not others? There is a developed antitrust methodology for assessing competition and market power, which is applicable here.[39] However, its application can be complex. Figure 3 illustrates the situation. Networks *A* and *B* can support application *1*, whereas network *C* can support application *2*. Networks *A* and *B* directly compete with one another, and this competition is relevant to the assessment of network *A*'s market power. Network *C* does not compete directly with network *A*. However, applications *1* and *2*

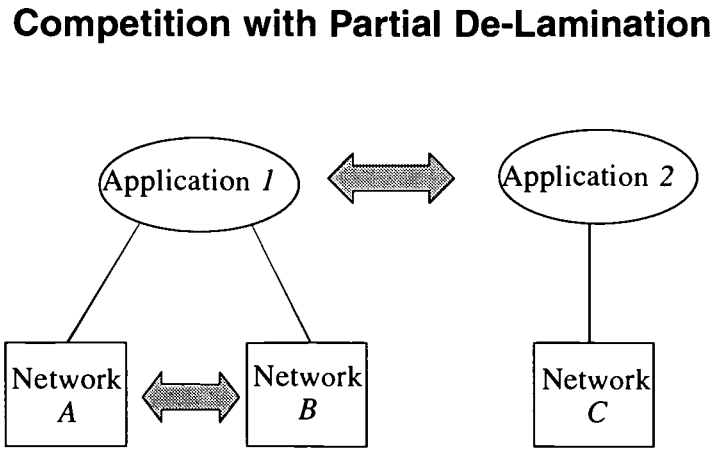


Figure 3

compete with one another, and thus networks *A* and *C* compete with one another indirectly. Of course, one must verify the strength of this indirect competition, but it is a potentially important factor. The key is not to lose sight of the issue: Does the provider of a particular service face sufficient competition that market forces will drive the firm to serve consumer interests and generally promote efficiency?[40]

IV. De-Lamination and Vertical Strategies

Thus far the discussion has examined competition in each layer separately. Even in a de-laminated world, however, service providers may pursue cross-layer strategies. Moreover, de-lamination may affect the desirability of social policies that limit vertical strategies.

A. Benefits and Costs of Vertical Separation

De-lamination is a technological development, but it has important implications for two related concepts of business structure: vertical integration and vertical bundling. Under vertical integration, a single supplier provides services in more than one layer. Under vertical bundling, services at different layers are offered for purchase (at the wholesale or retail levels) only as a package.[41]

Vertical integration and bundling raise three central questions for policy: First, are vertical bundling and integration socially desirable; second, will markets make the right choices; and third can government intervention improve matters in practice? Vertical separation has costs and benefits from the private perspectives of service suppliers and the public perspectives of policy makers. The answers to the previous questions turn on complex and disputed issues that are impossible to resolve in the course of a single paper. Rather than listing all of the costs and benefits of vertical separation, the following analysis identifies the factors that are most clearly affected by de-lamination and determines the directions of the effects.

There are at least three significant social benefits of vertical unbundling, all of which are affected by de-lamination. First, unbundling

allows the realization of *mix-and-match benefits.* A consumer can take the best offering at one layer and combine it with the best offering at a second layer, even if different firms provide the offerings. This benefit arises whether or not the firms in the industry are vertically integrated. Moreover, by improving the gross benefits that suppliers can offer to consumers, this effect is a commercial, as well as social, benefit.

A second benefit of vertical unbundling is that it *facilitates innovation* by allowing firms to engage in single-layer innovation. Unbundling generates, stimulates, and spreads innovation by making it feasible for a firm that is not vertically integrated to innovate at a single layer or allows an integrated firm to combine its innovative service at one layer with the services provided by different firms at other layers. The increased creation and diffusion of innovations can be expected to be a social benefit.[42] And to the extent that it improves the value proposition that firms can offer to consumers, increased innovation is a commercial benefit.

The mention of un-integrated suppliers raises a third effect of vertical unbundling: It *reduces industry concentration.* Vertical unbundling does this by preventing the most concentrated layer from driving overall concentration.[43] Moreover, vertical unbundling facilitates entry by allowing single-layer entry strategies, which reduce the risks associated with entry and lessen the need to acquire multiple skill sets. The increase in competition generally gives rise to social efficiency benefits and promotes consumer welfare. However, from the perspective of incumbent suppliers, increased competition is a "cost." Because it is a wedge between social and private evaluations of unbundling, the difference in views toward competition partially answers the question of whether markets will make the right choices: Private and social incentives toward vertical unbundling may diverge.

How does de-lamination affect the social benefits of unbundling? In short, it increases them. De-lamination makes it feasible to offer applications that are independent of the underlying transport. Thus de-lamination increases the potential for unbundling to facilitate mix-and-match benefits, single-layer innovation, and single-layer entry. Moreover, de-lamination and Swiss Army networks increase the *scope*

for mix-and-match, innovation, and competition benefits because a single network can be combined with many different types of application when unbundling occurs.

Vertical separation can also have effects that give rise to social costs. In particular, vertical separation may lead to a *loss of coordination in pricing and investment*, which also generate private costs. The concern with respect to pricing is the double marginalization problem identified by Cournot (1838). The following example illustrates the problem: Suppose every consumer requires one telecommunications service and one information service, each of which is supplied by a monopolist. Consider the incentives of the monopoly supplier of telecommunications to raise its price. If that firm is also the monopoly supplier of the information service (that is, it is vertically integrated), it will take foregone information-service sales into account when assessing the profitability of an increase in the price of its telecommunications service.[44] But if a separate firm sells the information service, the telecommunications monopolist will not count lost information-service sales as a cost and thus has less incentive to restrain price. This logic applies to pricing the information service as well. This line of reasoning thus indicates that the price of a telecommunications and information service bundle offered by an integrated monopolist will be lower than the sum of the unbundled component prices set by two distinct monopolists acting independently. A similar analysis can be applied to vertical bundling in settings in which there is imperfect competition at both layers.[45]

Vertical separation can also have negative effects on investment incentives. An innovation at the applications layer may generate benefits for suppliers at the transport layer, for example. If the potential innovator at one layer ignores the benefits realized by suppliers at another layer, the innovator's incentives are lower than if it took these benefits into account. The potential innovator may also ignore the effects on other service providers when choosing the direction of its innovative efforts, as well as their level. The problem of under investment is particularly acute if an innovation at one layer induces service providers at another layer to raise their prices to appropriate some of the benefits of the innovation; the price increase harms the innovator

and thus lowers that firm's incentives to undertake the innovation in the first place. This is a form of dynamic double marginalization.

Just as de-lamination and the rise of Swiss Army networks increase the benefits of vertical unbundling, they also reduce the costs. First, it follows from the logic above that static and dynamic double marginalization problems are considerably reduced when there is competition at one or both layers. De-lamination and Swiss Army networks thus reduce double marginalization by lessening concentration and increasing competition. Second, de-lamination greatly reduces the need for technical coordination on a firm-by-firm or application-by-application basis, which reduces losses from coordination costs to which unbundling might otherwise give rise.

In addition to increasing the social benefits and reducing the social costs of unbundling, de-lamination changes the nature of bundling. Transport networks that adhere to the Internet protocols necessarily are open to a wide range of applications. To date, issues of vertical bundling related to the Internet generally have not been that access to various content or sites is blocked. Indeed, the Commission declined to order open access in the AT&T/TCI merger in 1999 based on the parties' representation that customers would be able to reach any content on the World Wide Web.[46] Rather the issue is the bundling of transport with higher-level services that the end-user is forced to pay for even if she then chooses to make use of an alternative site or application.[47]

One way the openness of the transport layer could change is for on-net transport to support services that off-net transport does not.[48] This development would violate the layering principle of the Internet architecture and would give rise to proprietary networks. This possibility raises the broader issue of the costs of maintaining a layered architecture.

B. The Costs of De-Lamination

The preceding analysis assumes that de-lamination continues. But as technologies evolve, providers will have to cooperate to reach new standards that allow continuing de-lamination. This factor raises the question of whether the social and private benefits of de-lamination outweigh the costs.

The need to set rigid interfaces to allow different layers to work together may have the effect of freezing innovation, which is a social cost as well as a private cost for potential innovators. The experience of the Internet to date suggests that the value of having a universal distribution platform is greater than the costs, however the Internet does suffer from an inability to offer guaranteed quality of service in part because of the rigid protocols.

It is generally recognized that the Internet protocols will need ongoing updating. Will firms continue to support common protocols that allow de-lamination on an industry-wide basis, or will they turn to proprietary interfaces that create de-laminated silos? Because of the wedge between social and private incentives (for example, a provider is concerned only with benefits that it can appropriate), private firms tend to have fewer incentives to cooperate in setting the standards that make de-lamination possible than would a benevolent planner. However, the forces of competition may still be sufficient to induce firms to support common protocols. Updating of protocols will continue to be an important issue that policymakers should track carefully. Whether intervention will at some point be warranted remains to be seen.

V. The Importance of Definitions: The Universal Service Example

A variety of policies define rights and obligations based on regulatory names or labels. Universal service is one of the most important examples in terms of its effects on market outcomes and efficiency.

The set of firms that are required to pay universal service taxes is delineated in part by whether a provider offers interstate *telecommunications services*. This tax base is widely recognized (among economists, at least) as inefficiently narrow, regardless of the extent of de-lamination. Ideally, universal service would be funded out of general tax revenues collected economy-wide. De-lamination and the possibility of Swiss Army networks make the threat of efficiency losses from an overly narrow tax base even stronger.

The recent petition by the United States Telephone Association (USTA) and a related Notice of Inquiry by the FCC illustrate these

issues.[49] The USTA argued that cable companies that provide ISP services over cable modems are actually providing telecommunications services and information services bundled together. Moreover, the USTA argued that companies that offer cable modem services are telecommunications carriers and should make contributions to the universal service fund, based on their provision of interstate telecommunications services, in part because failure to do otherwise would violate "competitive neutrality," or service harmonization. To the extent that the services provided over cable modems are competing with other services provided over different networks (for example, telephone networks) that are subject to the universal service taxes at either the transport or application layers, current policies distort competition and generate efficiency losses.

In its Notice of Inquiry, the Commission asks whether ISP services over a cable modem should be considered as a cable service under the Communications Act.[50] Doing so would exempt the operators from paying universal service taxes on these services, but might open the operators to several other obligations, such as the assessment of local franchise fees. Determining the regulatory status of these services based on the underlying technology clearly would fail to recognize de-lamination and could be expected to lead to competitive distortions and efficiency losses.

De-lamination affects the issue of what services are eligible for universal service, as well as what services are taxed to fund it. In particular, de-lamination raises the issue of which layers are covered by universal service. The well-known text of Section 254 of the 1996 Act states :

> Universal service is an evolving level of *telecommunications services* that the Commission [FCC] shall establish periodically under this section, taking into account advances in telecommunications and information technologies and services. [Emphasis added.][51]

This definition appears to apply to the transport layer. But the FCC's policies typically are expressed in terms of the voice application coupled with the underlying transport network required to offer voice services

using a circuit-based technology. In the future, policy-makers will have to confront the question of whether they really mean the transport layer. To what extent will universal service subsidize specific applications (for example, voice and secure e-commerce) versus transport services? For low-income consumers, a sensible policy might subsidize both transport and applications. For consumers in so-called high-cost areas, the high costs generally are associated with the transport layer. In a fully de-laminated world, the costs of applications are largely independent of location, with the possible exception of the costs of installing specialized customer premises equipment to support particular applications. If installation necessitates a truck roll, installation costs may be higher in sparsely populated areas. Generally, however, it appears unlikely that low-cost support will be an issue at the applications layer.

VI. The Internet as a Wedge for Policy Reform

To date, the FCC has pursued a policy of granting favorable regulatory treatment to what it considers to be "the Internet." Although observers sometimes refer to this policy as "unregulation," the FCC does in fact regulate important aspects of the Internet.[52] For example, the FCC has continued and extended the Enhanced Service Provider Exemption to include Internet Service Providers (ISPs) and thus excuse them from paying interstate access charges.[53] In doing so, the FCC has subjected the provision of transport for dial-up Internet access to price regulation. The FCC , with occasional prodding from the federal courts, has also forced telephone carriers to allow users to connect their own terminal equipment to local exchange telephone networks, which allows the use of modems.[54] The provision of Internet access is also affected by the FCC's actions to force incumbent local exchange carriers to allow other providers to offer end users digital subscriber line (DSL) services, using the incumbents' loop facilities.

As noted earlier, technology has not yet moved to the point at which perfect regulatory arbitrage is possible. Thus, policies that violate harmonization can persist. But are such policies desirable? There are sever-

al possible rationales for the differential treatment of the Internet, each of which raises serious concerns.[55]

One view is that regulatory reform or de-regulation is needed, but for a variety of political and institutional reasons it is too difficult to reform the regulation of established telecommunications technologies. Under this view, the Internet provides a clean slate on which to get things right, which may include having no regulation at all, given the possibilities for increased competition.

This view is suspect because it ignores de-lamination. It distinguishes the voice-over-IP application based on the underlying transport technology: The slate is being defined as if it were one layer, when in fact it is two (or more). Moreover, the slate is clean at neither layer in the sense of being separate from existing services. The Internet does not operate separately from the rest of telecommunications in terms of being either physically separate or part of separate product markets. In many instances, the Internet relies on the underlying, old-fashioned, public switched network for transport. And even if it did not, Internet services compete with old-fashioned services in some cases. Thus, the policy approach of de-regulation violates the principles of both service and medium harmonization. The lack of harmonization, whether it is intentional or not, can distort both consumer consumption decisions and supplier investment decisions. For example, if voice-over-IP continues to evolve as a substitute for traditional voice telephone service, and voice-over-IP continues to be exempt from burdens placed on traditional voice service, then consumers will face price differentials between traditional and IP voice that do not reflect true cost differentials. Moreover, providers will have artificial incentives to invest in voice-over-IP.[56]

A different version of this rationale for favoring the Internet recognizes these problems but sees them as an inevitable cost of breaking a political logjam. With this view, the idea is to create a crisis so large that long-overdue reforms finally take place. The problems with this view are twofold. First, if the crisis is not resolved quickly, the costs of the distortions may be very large. These costs would be especially large if the regulatory distortions drive providers' long-term investment decisions.

Second, by itself this approach does not suggest what reforms should be undertaken. In fact, the distortions induced by the lack of harmonization may obscure other fundamental problems with the underlying regulatory regime and thus serve as an obstacle to needed reform.

A final rationale for differential treatment of the Internet is an *infant-industry*, or industrial policy, argument. This line of argument holds that the Internet needs help in getting started. Some observers assert that the United States' lead in Internet connectivity is the result of the regulatory decision to force local exchange carriers to offer price-capped, flat rate charges for the transport of dial-up access.[57] Of course, these observers ignore the fact that this pricing often fails to cover costs and consequently may partially explain why the United States lags behind much of the world in the adoption of wireless Internet technologies, which do not receive a comparable subsidy. The problem with infant-industry policies generally is that they may induce unintended distortions, as well as the intended ones. Moreover, observers widely note that infant industries often fail to admit that they have grown up and no longer need protection.

VII. Conclusion

Policymakers should take the effects of technological change in telecommunications networks into account. It is much more than learning to say that packet networks are different from circuit networks. Public policy analysis should recognize de-lamination, examine the different layers separately, and carefully assess their relationship on a case-by-case basis. Public policy should also take into account the implications of innovation for regulatory game playing and the resulting distortions.

There are three views of how the technological changes discussed in this paper will affect telecommunications policy in the coming years. The most optimistic view is that these changes will create competition that eliminates the need for all but minimal governmental intervention, in the form of standard antitrust and consumer protection policies. This view is far too optimistic, at least for the next five to ten years. Another view is that these forces will simply make the old problems worse, increasing the distortions and efficiency losses associated with

poorly designed policies. One hopes that this view is too pessimistic, and the correct view is that these forces will provide the impetus to make long overdue changes. Keep your digits crossed.

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Notes

1. I would like to thank A. Richard Metzger and participants in the Fifteenth Annual Aspen Institute Conference on Telecommunications Policy (particularly the members of Group A) for helpful discussions of these issues. While I have consulted for a number of clients in government and the telecommunications industry, the views expressed here are solely my own and represent neither those of any current or former client, nor anyone with whom I have discussed earlier drafts.

2. There are other ways to conceptualize the layers, such as the seven-layer OSI model.

3. For a discussion of the hourglass architecture, see Computer Science and Telecommunications Board (forthcoming).

4. Another feature of the Internet architecture is that information is broken into packets. While this feature has received considerable attention in policy discussions, its implications for regulation are not as fundamental. There are places at which regulation reflects a circuit-switched mentality, but (conceptually at least) these policies can be updated to deal with packets. The biggest issue is the feasibility of monitoring at the packet level to determine the jurisdiction or regulatory category into which a message falls.

5. The astute reader will notice that neither of these developments is entirely new. The plain old telephone network exhibits both characteristics to a degree; it can carry voice, facsimile, and data (via analog modem) without special adaptation.

6. On an intermediate basis, however, there may be need for increased regulation of carrier-to-carrier relationships as the number and types of suppliers increase.

7. See Entman (2000).

8. See Katz (2000).

9. To the extent that the process is purely one of re-labeling, regulatory arbitrage undermines the policies trying to impose differential treatment, but by itself does not distort consumption, production, and investment decisions.

10. This is not to say that service harmonization is not important at the applications layer, just that it is not driven by the rise of Swiss Army networks.

11. Two very useful papers that address many of the issues examine here are Werbach (1997) and (2000). And, of course, the discussion summary of the Fifteenth Annual Aspen Institute Conference on Telecommunications Policy prepared by Robert Entman provides insightful discussion.

12. Admittedly, this is a bit fuzzy. Price caps have the same effect. This definition implicitly excludes obligations intended to limit the creation or exercise of market power.

13. Of course, such policies have not been eliminated. Spectrum policy continues to limit the ability of parties to use various bandwidths to offer particular services in competition with other providers.

14. "Apparently" because one can ask whether firms subjected to public policy should be allowed

to finance a more complete review of their situation if they believe current regulatory treatment is inappropriate.

15. The pricing of the local telephone network services provides an illustrative example more generally. Even though local calls on an incumbent carrier's network, long distance calls, wireless-to-fixed calls, calls to Internet service providers, and entrant-to-incumbent local calls all place very similar demands on the incumbent's local network, they have been subject to very different regulatory regimes, particularly with respect to pricing. This has led to endless (and at times bizarre) debates about how to classify a given call.

16. Simon Singh, *The Code Book* at 80. New York: Anchor Books. 1999.

17. Kennard (2000).

18. For an early discussion of concerns about gaming of regulatory service definitions, see Federal Communications Commission (1980).

19. This fact does not, however, imply that reciprocal compensation had no effect on calling patterns and efficiency. It implies only that *net* payment flows are small.

20. Telecommunications Act of 1996, Pub. L. 104-104, 110 Stat. 56, February 8, 1996. The 1996 Act amends the Communications Act of 1934, codified at 47 U.S.C. §§ 151 et seq.

21. 47 U.S.C. § 254 (d).

22. Id. § 251.

23. Id. § 222.

24. See Federal Communications Commission (2000) footnotes 46 and 48, and references therein.

25. 47 U.S.C. § 153(43).

26. Id. § 153(46).

27. Id. § 153(20).

28. See, for example, Federal Communications Commission (1998).

29. Federal Communications Commission (2000) at 18 and 19.

30. Municipalities are involved in various rights-of-way issues for wireless and wireline carriers.

31. See Nadler (1995) for a history of disputes between federal and state regulators over their division of responsibility. Katz (2000) provides a general discussion of possible principles for assigning jurisdiction.

32. There is also a need to recognize that there are layers within layers (for example, within transport, DSL is a layer on top of the copper).

33. If transport networks are not interconnected, then installed bases and network effects may become sources of significant market power.

34. This definition suffices for assessment of market power. In order to avoid stifling investment incentives, policymakers should also examine whether the assets were acquired solely through past "hard work" before implementing policies to limit the exercise of the resulting market power. See Katz (2000).

35. Network effects exist when the value of a service to a given end user increases with the number of other users of that service.

36. A key policy question is when, if ever, a firm with market power due to network effects should be forced to make its application interoperable with those of rivals. For example, AOL has by far the largest number of instant messaging subscribers—an application subject to network effects—and its system is not interoperable with those of rivals. Even with perfect vertical separation, issues of within-layer interconnection remain thorny.

37. Notice that under this analysis, voice telephony is *not* a telecommunications service. The underlying transport is a telecommunications service, but the voice application is not.

38. This statement is based on the economically irrational pattern of service-specific pricing that regulators have imposed on various services provided by local exchange telephone networks.

39. See, for example, U.S. Department of Justice and the Federal Trade Commission (1997).

40. The relevant policy question sometimes takes slightly different forms. In merger policy, for example, the question is whether merger would significantly reduce competition. But the overall thrust is similar, as are the appropriate modes of analysis.

41. While related, vertical integration and bundling are distinct concepts. A vertically integrated firm may offer its services at each layer separately from one another. And two un-integrated firms may offer their services under terms that make it impossible to use one service without the other.

42. As a matter of theory, firms may invest more than the socially efficient amounts in research and development (R&D). As an empirical matter, however, evidence indicates that private incentives for R&D typically are much lower than the social benefits of the R&D, because private firms typically are unable to appropriate all of the benefits that their R&D generates for the economy. See, for example, Griliches (1992) and Jones and Williams (1998).

43. The 1996 Act's attempt to foster local loop resale can be viewed as a regulatory policy that recognized layers and tried to create competition at the applications layer in the absence of competition at the transport layer.

44. For simplicity, I am assuming that the different parts of a vertically integrated company behave as a unitary decision maker. In reality, vertical integration is not this effective, and divisions of companies sometimes complain that they are treated worse by their corporate siblings than are outside customers and vendors. Consequently, this assumption overstates the benefits of vertical integration and the costs of separation.

45. One has to be a bit careful here and recognize that vertical integration can help solve double marginalization problems while still having unbundling. Specifically, a vertically integrated firm that has strong market power at one level may allow independent suppliers to combine their services with the integrated firm's services and then engage in "squeezes" that limit the independent firms' margins. For a formal treatment of these issues, see Farrell and Katz (2000).

46. Federal Communications Commission (2000) at 12.

47. This type of bundling was a key issue in the Federal Trade Commission's approval of America Online's acquisition of Time Warner, which required that consumers be offered a choice of Internet Service Providers over Time Warner's cable systems. Labaton (2000).

48. "On net" refers to traffic that is carried entirely on a single provider's network.

49. See USTA (2000) and Federal Communications Commission (2000).

50. Federal Communications Commission (2000) at 17.

51. 47 U.S.C. § 254.

52. See, for example, Oxman (1999).

53. The Enhanced Service Provider Exemption treats providers of *enhanced services* (a terms which parallels *information services*) as end users of local exchange telephone networks and exempts these providers from having to pay interstate access charges, such as those paid by traditional long distance telephone providers. (*MTS and WATS Market Structure*, 97 FCC 2d 682 (1983); 711-22.)

54. For a discussion of Commission decisions in this area, see Oxman (1999) at 13-15.

55. In addition to the rationales discussed here, the Commission has offered a different rationale for not imposing pricing or interconnection requirements on high-speed transport services offered by cable operators: competition is just around the corner. (Federal Communications Commission (2000) at 4.) If competition is indeed imminent, then the costs of imposing a new regulatory regime would very likely outweigh the transitory benefits.

56. There are arguments for treating providers of competing services differently. See Katz (2000). One might treat the providers differently if they have varying degrees of market power, or one might choose to treat some providers differently on the grounds that only some firms need to be regulated to discipline all providers. But neither rationale justifies a protocol-based distinction. And neither rationale would justify exempting one technology from taxes, such as universal service contributions.

57. For a representative statement of this view, see Oxman (1999) at 17 and 18.

APPENDIX

The Fifteenth Annual Aspen Institute
Conference on Telecommunications Policy

August 12-16, 2000
Aspen, Colorado

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About the Authors

Robert M. Entman is professor and head of the Department of Communication, and co-director of the Center for Information Society Studies, at North Carolina State University. Dr. Entman teaches courses in mass media, political communication, and telecommunications policy. Holder of a Ph.D. in political science from Yale and an M.P.P. in policy analysis from the University of California, Berkeley, he served previously on the faculties at Northwestern University and Duke University. He has also been a Visiting Professor in the Lombard Chair at Harvard University. Dr. Entman is the author and co-author of numerous books and articles including *The Black Image in the White Mind: Media and Race in America, Mediated Politics: Communication in the Future of Democracy, Democracy Without Citizens: Media and the Decay of American Politics, Diversifying TV and Radio: Policies for Privatization and the Public Interest in Broadcasting,* and *Media Power Politics.* Dr. Entman has consulted and written or co-written many reports for government agencies and other organizations, the most recent of which are *Media and Reconciliation,* for President Clinton's Initiative on Race (March, 1998) and *Residential Access to Bandwidth: Exploring New Paradigms* (Aspen Institute, 1999). He serves as co-editor of the book series *Communication, Society and Politics* for Cambridge University Press with Lance Bennett, and as editorial board member for *Communication Law and Policy, Communication Review* and *Political Communication.* Dr. Entman is chair-elect of the Political Communication Section of the American Political Science Association.

Michael L. Katz is the Edward J. and Mollie Arnold Professor of Business Administration at the University of California, Berkeley. He also holds an appointment as professor in the Department of Economics and serves as the director of the Center for Telecommunications and Digital Convergence. He has twice won the Earl F. Cheit Awards for outstanding teaching. Dr. Katz has published numerous articles on the economics of networks industries, intellectual property licensing, telecommunications

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The Aspen Institute Communications and Society Program

The overall goal of the Communications and Society Program is to promote integrated, thoughtful, values-based decision making in the fields of communications, media, and information policy. In particular, the Program focuses on the implications of communications and information technologies on democratic institutions, individual behavior, instruments of commerce, and community life.

The Communications and Society Program accomplishes this goal through two main types of activities. First, it brings together leaders of industry, government, the nonprofit sector, media organizations, the academic world, and others for roundtable meetings to explore the political, economic, and societal impact of communications and information infrastructures. Second, the Program promotes research and distributes conference reports to local, national, and global decision makers in the communications and information fields, and to the public at large.

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Charles M. Firestone is executive director of the Aspen Institute Communications and Society Program. Prior to joining the Aspen Institute in 1989, Mr. Firestone was director of the Communications Law Program at the University of California, Los Angeles (UCLA) and an adjunct professor at the UCLA Law School. He was also first president of the Los Angeles Board of Telecommunications Commissioners. Mr. Firestone's career includes positions as an attorney at the Federal Communications Commission, as director of litigation for a Washington, D.C. based public interest law firm, and as a communications attorney in Los Angeles. He has argued several landmark communications cases before the United States Supreme Court and other federal appellate courts.

Previous Publications of the Aspen Institute Conference on Telecommunications Policy

The following publications were all authored by Robert M. Entman

Six Degrees of Competition: Correlating Regulation with the Telecommunications Marketplace

This report addresses the basic conceptual questions of what should be the nature of regulation in a competitive, broadband future. It also examines how fundamental policy questions such as interconnection, mergers, spectrum allocation, jurisdiction, universal service, and consumer protection should be handled in the interim. The report also includes "Regulation: The Next 1000 Years," by Michael L. Katz.

2000, 65 pages, ISBN Paper: 0-89843-279-0, $12.00 per copy

Residential Access to Bandwidth: Exploring New Paradigms

This report explores policy initiatives that would encourage the widespread deployment of residential broadband services throughout the United States. It identifies our regulatory system as one of the chief obstacles to achieving ubiquitous broadband deployment and offers a new regulatory model to overcome these barriers.

1999, 35 pages, ISBN Paper: 0-89843-256-1, $12.00 per copy

Competition, Innovation, and Investment in Telecommunications

This report considers how public policy can foster investment, competition, and innovative services in local exchange telecommunications. The volume also includes "An Essay on Competition, Innovation, and Investment in Telecommunications," by Dale N. Hatfield and David E. Gardner.

1998, 52 pages, ISBN Paper: 0-89843-235-9, $12.00 per copy

Implementing Universal Service After the 1996 Telecommunications Act

This report summarizes the Conference's suggestions for universal service policy options, generally, and financing options for schools and libraries, specifically, which were submitted to the Federal-State Joint

Board on Universal Service in September 1996. The report includes an appendix with sections of the Telecommunications Act of 1996 that relate to universal service. $10.00 per copy

The Communications Devolution: Federal, State, and Local Relations in Telecommunications Competition and Regulation

In the context of landmark communications legislation, this report examines the forces shaping the competitive world of telecommunications, and offers federal, state, and local regulators a roadmap to resolving jurisdictional disputes and promoting effective competition.

1996, 64 pages, ISBN Paper: 0-89843-190-5, $10.00 per copy

Strategic Alliances and Telecommunications Policy

The report examines the underlying trends and motivations in the emergence of strategic alliances in the provision of telecommunications. It then explores the implications of these alliances, suggests tools and methods of analysis for viewing these alliances, and addresses, from a public policy perspective, what remedies and actions might be advisable in the near and long-term future.

1995, 26 pages, ISBN Paper: 0-89843-170-0, $10.00 per copy

Local Competition: Options for Action

This report sets forth the compromise universal service funding plan arrived at by conference participants. It also describes approaches to removing barriers to local competition and addresses issues associated with competition in other fields by incumbent carriers. It includes an essay by Eli Noam entitled, "Reforming the Financial Support System for Universal Service in Telecommunications."

1993, 38 pages, ISBN Paper: 0-89843-150-6, $10.00 per copy

Competition at the Local Loop: Policies and Implications

This report examines the trend toward greater competition in telecommunications, with new competitors such as cellular telephone, paging, cable television, private telecommunications providers, personal communications service experiments, satellites, and long-distance providers. It seeks to develop sound options for future public policies and addresses issues of universal service and jurisdictional control and preemption.

1993, 28 pages, ISBN Paper: 0-89843-130-1, $10.00 per copy

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