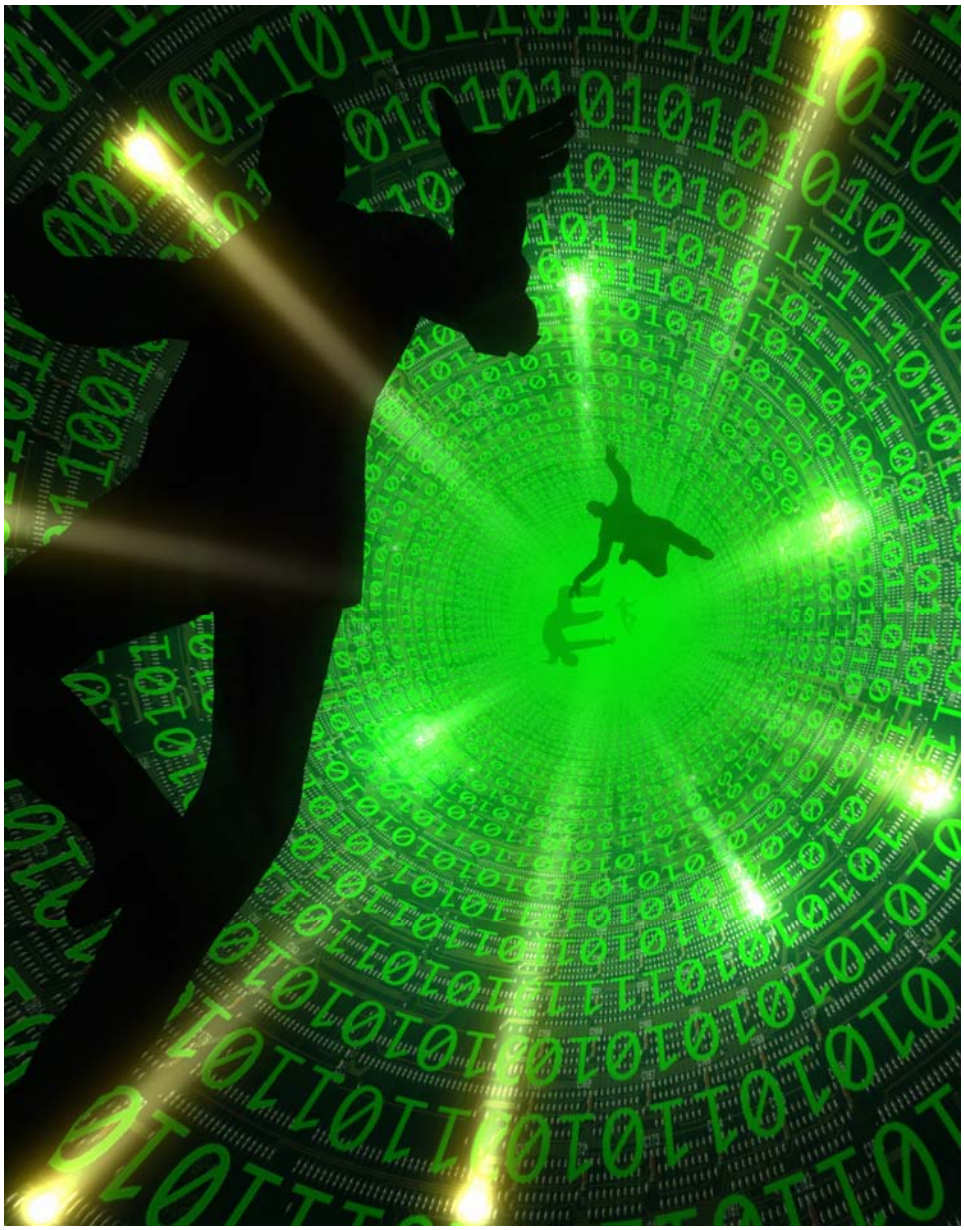
Free Ride: Deficiencies of the MCI 'Layers' Policy Model and the Need For Principles that Encourage Competition in the New IP World



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Braden Cox is technology counsel with the Competitive Enterprise Institute's Project on Technology and Innovation in Washington, D.C. His work lies at the intersection of law and technology relating to e-commerce, intellectual property, telecommunications, and cybersecurity. He concentrates on the ways that government approaches to regulating technology and the Internet hurt consumers and stifle innovation. He is a frequent guest on radio programs and his articles have recently appeared in such publications as the Chicago Sun-Times and National Review Online. Mr. Cox is the former counsel at Veriprise Wireless, a technology venture based in Atlanta. Mr. Cox obtained both his undergraduate finance degree and law degree from the University of Georgia. He is a member of the District of Columbia, Georgia, and Virginia state bars.

James L. Gattuso is a research fellow in regulatory policy in the Roe Institute for Economic Policy Studies, where he handles regulatory and telecommunications issues for The Heritage Foundation. Prior to joining Heritage, he was vice president for policy at the Competitive Enterprise Institute. In that position, he oversaw CEI's policy work, and supervised the overall management of the organization. Before joining CEI, Mr. Gattuso was vice president for policy development with Citizens for a Sound Economy (CSE) from 1993 to 1997, where he directed the research activities of that organization. From 1990 to 1993, he was deputy chief of the Office of Plans and Policy at the Federal Communications Commission. Mr. Gattuso graduated Magna Cum Laude from the University of Southern California in 1979. He received his J.D. degree from the University of California at Los Angeles in 1983, where he was a member of the UCLA Law Review. He is a member of the California and District of Columbia bars and is the author of a number of articles written for newspapers, magazines and journals.

David P. McClure is president and chief executive officer of the U.S. Internet Industry Association, the primary U.S. trade association for Internet commerce, content, and connectivity. A technologist by education and experience, Mr. McClure has held positions in the Internet, computing, aerospace, and environmental services industries. He has served on the staff of the Aviation and Space Writers Association (AWA) and the Software Publishers Association (SPA). He has served at the helm of the USIIA since it was founded in 1994. He is also a member of the American Society of Association Executives and its Technology Section Council. Mr. McClure has written and lectured extensively on management and technology issues, and is considered an authority on technology applications for business.

Andrew Odlyzko is director of the Digital Technology Center, holds an ADC Professorship, and is an Assistant Vice President for Research at the University of Minnesota. Prior to assuming that position in 2001, he devoted 26 years to research and research management at Bell Telephone Laboratories, AT&T Bell Labs, and AT&T Labs. He has written over 150 technical papers in computational complexity, cryptography, number theory, combinatorics, coding theory, analysis, probability theory, and related fields, and holds three patents. He has an honorary doctorate from Univ. Marne la Vallee and serves on the editorial boards of over 20 technical journals, as well as on several advisory and supervisory bodies. He is best known for an early debunking of the myth of Internet traffic doubling every three

or four months. Mr. Odlyzko received a B.S. and M.S. in Mathematics from the California Institute of Technology and a Ph.D. in Mathematics from the Massachusetts Institute of Technology.

Stephen B. Pociask is president of TeleNomic Research, LLC and has worked in and consulted for telecommunications and high-tech industries for over twenty years. Mr. Pociask conducts a wide variety of applied economic studies, including those dealing with public policy, regulatory economics, and antitrust issues. He has provided consulting primarily for high tech firms, including those providing high-speed Internet services, local and long distance services. He has appeared numerous times in the media, including *Bloomberg News, CNBC, Telecommunications Reports, Telephony, Congressional Quarterly, Americas Network, Network Magazine*, and *CNET Radio*. From 1998 to 2000, Mr. Pociask was chief economist and executive vice president for Joel Popkin and Co., an economic consulting firm in Washington, D.C. Before that, he worked eighteen years in the telecommunications industry. He has completed his Ph.D. coursework in economics and has an M.A. in economics from George Mason University.

Adam Thierer is director of telecommunications studies for the Cato Institute where he conducts research on how government regulations hamper the evolution of communications networks, including telephony, broadcasting, cable, satellite and the Internet. He also examines the broader economic and constitutional aspects of telecommunications policy. His writing has been published in the *Washington Post*, *Newsweek*, *Wall Street Journal*, *Investors Business Daily*, *Journal of Commerce*, *Forbes*, and *The Economist*. Mr. Thierer has made media appearances on National Public Radio, PBS, Fox News Channel, CNN, MSNBC, BBC, Radio Free Europe and Voice of America. Prior to joining Cato, he spent nine years at The Heritage Foundation, where he served as the Alex C. Walker Fellow in Economic Policy, covering telecommunications and Internet policy, antitrust, electricity and energy policy, the airline industry, and federalism. Mr. Thierer earned his bachelor's degree in political science and journalism at Indiana University and received his master's degree in international business management and trade theory at the University of Maryland.

Glenn A. Woroch is an adjunct professor of economics at the University of California at Berkeley, and executive director of the Center for Research on Telecommunications Policy located in the Haas School of Business. He conducts theoretical and empirical investigations of competition and regulation of network industries, with particular application to the telecommunications and computer sectors. His research also examines antitrust policy toward intellectual property protection and various business practices. Professor Woroch has been an economic advisor to government agencies including the U.S. Departments of Commerce, Energy, and Justice. He regularly consults to private-sector clients and testifies on matters involving monopolization claims, mergers, intellectual property infringement, and economic damages. Professor Woroch received a B.A. from the University of Wisconsin-Madison, and an M.A. (Statistics) and Ph.D. (Economics) from the University of California-Berkeley.

EXECUTIVE SUMMARY

Preface

Technology, innovation, and competition are reshaping the communications business and the overall "Information Economy." As current broadband networks are built out and consumers begin to subscribe to new higher-speed Internet services, regulators are faced with increasing pressures to answer basic regulatory questions regarding how these networks and services should be treated.

Communications businesses are reexamining how they do business. These businesses have been hit hard in the last few years. While there has been some investment in telecom, the spate of telecom investment has not proved to be sustainable. Both local and long distance revenues continue to fall. Government-set price controls and requirements for unbundling have eroded incentives to invest in new wireline networks. Federal Communications Commission's data show that competitors are abandoning their own access lines to piggyback on the old networks.

Government is reexamining how it does business, too – particularly whether, why, and how it regulates. In the past, when new technologies appeared, regulators were able to place the technologies in discrete service categories (e.g., TV, cable TV, telephony, satellite, etc.), or as they are often referred to, "silos." With the rapid advent of new ways to deploy broadband networks and the myriad of applications and services, some observers and industry players argue that these traditional silos are inadequate to address the multitude of new regulatory questions that the inventors of the old service categories did not foresee. Some have called for new ways to regulate.

Origins of the Project

In this report, the New Millennium Research Council[1] (NMRC) continues to explore telecommunications policy issues by providing a compendium of papers from noted telecommunications experts and academics on the future of telecommunications regulation, particularly as the industry moves toward Internet Protocol (IP) based networks.

A new policy framework advocated by MCI recommends moving away from existing regulation by FCC service "silos" to an approach based on the engineering "layers" of Internet platforms. This framework includes different "layers" such as the physical, logical, applications, and content layers. While the layers model provides engineers with a good technical description of the way in which contributors to the network interoperate, there has been little evaluation or assessment of the proposed model as a useful public policy tool. MCI has presented its proposal in several forums and is now advocating its adoption for possible new telecommunications legislation. How well it could be imposed on today's "Information Economy" – and, at what potential cost – are some of the points that are addressed here.

Key Questions for the Layers Approach

The NMRC invited a diverse range of telecommunications experts from industry and academia to examine the MCI network layers policy approach and its related legislative proposal. It asked the authors to provide comments on such questions as:

1. Is MCI's network layers model feasible, both economically and politically? What are the real-world implementation issues?
2. What are the fiscal and investment implications of a network layers policy model? Who pays for investment in the underlying physical layer? Does MCI's model ensure that network investment, technological innovation, and public social obligations are met in the digital age?

[1] Since 1999, the NMRC has investigated a range of issues related to competition in the telecommunications industry. The NMRC has also sponsored a number of roundtable events in Washington, D.C., and legislative briefings on various topics. See our website at www.newmillenniumresearch.org for copies of the reports and transcripts of prior events.

3. What benefits does vertical integration across 'layers' provide for consumers? Will long-term facilities-based competition emerge? Will this model delay or limit new technologies and services?
4. What alternatives, if any, can encourage competition, promote technology innovation, and benefit consumers? What policies can encourage network investment?

While this list is not exhaustive, the NMRC felt that the authors should address a number of critical questions for regulators to thoroughly explore and answer about the MCI network layers approach before considering its usefulness as a public policy model.

The authors of these papers do not fully examine all issues and concerns regarding a layers policy model for telecommunications. Observers might ask whether now is the best time to embark on a sweeping and potentially disruptive overhaul of telecommunications laws? Would such an overhaul deter the investment community from making much-needed investments in communications at this critical time? How would such a wholesale change affect critical infrastructure protection, homeland security needs, access for law enforcement, or universal service? These are just some additional questions that will need to be addressed before regulators and lawmakers consider any changes to current telecommunications laws.

The Experts Speak

This report presents the views of eight telecommunications experts who provide their perspectives and recommendations on the MCI network layers framework including what it means, what it would do, and the key litmus tests for implementing such a model if it is viable. The authors raise important questions about the practicality of the layers model as well as the costs of new regulation and going down a path that may later prove to be a regulatory "mistake." The authors provide alternative views for appropriate treatment of IP-enabled networks that can be acted upon quickly and fairly for all stakeholders and recommend principles that promote increased competition, new services and innovation, and encourage widespread deployment of digital networks as well as meet current social obligations.

In the opening essay, James L. Gattuso, research fellow in regulatory policy at The Heritage Foundation, provides the necessary background overview of key telecommunications policy questions that regulators will need to answer before considering any new regulatory scheme, particularly one based on network layers. Gattuso admits that the current regulatory scheme is insufficient and "is quickly breaking down." Gattuso writes, "The concept of layering – at the theoretical level – is relatively uncontroversial…Yet, the idea – especially as elaborated upon by subsequent analysts – does have some very specific implications for policy." He notes that a layered model raises significant questions such as: Could open access dilute incentives to invest, as well as make integration of services more difficult, to the detriment of consumers? Instead of benefiting consumers, would limiting such integration make cost cutting more difficult, thereby hurting consumers? Would such limits freeze into place current layer structures, preventing the network from evolving? Would we simply be exchanging one system of arbitrary regulatory categories for another?

Gattuso concludes, "The Whitt policy proposals seem to assume that many providers, such as telephone companies have undue market power. But is this assumption warranted, given the number of competing providers offering this service? Moreover, do such conclusions flow from layering theory? Or does this simply re-hash long-standing debates over telephone competition in a new guise?"

Wayne Brough, chief economist of Citizens for a Sound Economy, explains the irony of proposing to maintain, indeed, increase the level and intensity of government regulation of the physical layer at precisely the same time that facilities-based companies (e.g., cable and telephone companies) are confronted with more and more intense competition from other sectors of the telecommunications industry.

"It [the layers model] offers little to ease the current regulatory impasse. In fact, the current problems that plague the telecommunications sector would persist, if not intensify, in a new regulatory model based on network layers," writes Brough. "Perhaps the most troubling aspect of the layered approach outlined by MCI is the fact that it makes no effort to address problems imposed by the UNE-P[unbundled network element platform]…Rather than eliminating the UNE-P or revisiting the TELRIC [total element long-run incremental cost] pricing formula, it is viewed as 'an interesting blend of horizontal and vertical thinking' necessary for promoting intramodal competition." Brough concludes, "Unfortunately, this approach would continue to impose regulatory impediments that inhibit critical infrastructure investment and limit growth in the telecommunications sector."

Braden Cox, technology counsel for the Competitive Enterprise Institute, discusses why an engineering construct may not prove a sound basis for a lasting regulatory scheme. He particularly highlights some of the serious potential costs and risks, a theme that is also addressed by Adam Thierer of the Cato Institute. "On its face, the layers model is a seductive analytical tool that improves upon the current lack of cohesiveness in telecom regulation," writes Cox. "However, what is a superior analytical tool for network engineers is not necessarily good for network regulators. It is burdened with the same regulatory traps of current law – it retains too much faith in the capability of government regulators to beneficently intervene in the market."

David McClure, president and CEO of the U.S. Internet Industry Association, writes that the layers model is predicated on a largely imaginary, idealistic view of the Internet. McClure notes that there are substantial costs associated with trying to establish government-drawn lines of demarcation in a field characterized by convergence. McClure finds a number of "inherent" problems with the proposed network layers model including: (1) the model doesn't accurately represent the Internet – the model is a gross simplification of the elements that make up the Internet, with no appropriate reference to how those layers interact or relate, (2) the model "criminalizes competition" by punishing success in the market, (3) the model fragments the Internet industry leaving it without cohesion and leadership needed for the Internet industry to grow, mature, and thrive, and (4) the model inhibits rural deployment of broadband forcing providers to target dense urban areas.

Andrew Odlyzko director of the Digital Technology Center at the University of Minnesota makes an important point: The layers approach would entail increasing government regulation of wireless and cable television networks, two parts of the Information Economy that have thrived with minimal government regulation. Odlyzko notes that the layers approach would be exceedingly complex and is unlikely to command any significant private sector consensus, thus heightening implementation costs. He also indicates how constraining business decision-making could have a serious adverse impact on prices and customer choice.

"There is also a very fundamental problem with the layer model, related to the inhibiting effect it would have on price discrimination," notes Odlyzko. "Differential pricing, in which customers pay varying prices for what may be essentially the same goods or services, is at the heart of regulation." For example, he cites that users pay rates per megabyte of data varying between $0.0001 (for movies delivered over cable) to $3000 (for text messages over wireless). "This creates strong economic incentives for price discrimination, and against charging per byte or per packet. A physical layer service provider that charged just by the volume of traffic could not take advantage of the variation in willingness to pay. But it is the basic connectivity provider that has the high costs that are of greatest concern in discussions about deployment of broadband, at least for residential users."

In his piece, Stephen Pociask, president of TeleNomic Research builds upon several themes. He notes that the layers approach assumes that any efficiencies of integration are small, or could be sacrificed with little net loss, as they would be offset by other gains. There is scant basis for this thinking, however, he observes. Much of the layers approach ignores the need to spur investment in the physical infrastructure upon which applications – and, users -- will "ride." Yet the layers model contains powerful disincentives for facilities investment, he notes.

Pociask writes that the layers model makes "transport services look like a commodity. What the proposal offers to fix, the compartmentalizing of industries, it breaks by compartmentalizing competitors into layers. The proposal

places no value on economies of scope and vertical integration, ignoring network efficiencies that provide consumers low costs." He says MCI's layers model takes the most costly function of the communications business – building and operating the transport network – and leaves it under onerous regulations, but it frees more profitable services from regulation. "Effectively, the MCI proposal works to separate regulated and unregulated competitors, which would perpetuate regulations and protect companies that have not invested in telecommunications infrastructure."

Adam Thierer, director of telecommunications studies at the Cato Institute, asks a fundamental question for the government's role in regulating any industry: Should government intervene to tell businesses how to organize to do business? At present, most businesses enjoy significant organizational and investment discretion – and, they bear the risks of choosing wrongly. The layers approach, as presented by MCI, appears to promote setting a governmental "industrial policy," and Thierer highlights the serious costs such a policy could impose in terms of inhibiting investment and innovation.

"Is today's Internet the only one we will ever know?" asks Thierer. He wonders if it is unthinkable to envision a world with multiple Internets, or "Splinternets." He writes, "Although 'layers' offer a fitting way of thinking about today's world, just as vertical silos made sense in the past, it could be the case that horizontal layers will not accurately describe the Internet, or Internets, of the future." Thierer adds that as a matter of public policy, "dumb pipes should not be mandated as the law of the land since there are good reasons to allow competition in network architectures between dumb and smart systems to see which consumers truly prefer. Perhaps the most important reason to reject dumb pipe mandates lies in the investment disincentives for both existing and potential infrastructure operators."

"Another drawback of imposing this engineering architecture on regulatory policy is that technology can change, and can do so quite quickly, while regulatory institutions are notoriously slow to react and to adjust," writes Glenn Woroch, executive director of the Center for Research on Telecommunications Policy at the University of California. "Incorporating the horizontal approach into institutions builds in rigidity that prevents regulation from adapting to the very innovative technologies that it seeks to promote. Who could claim that technological advances will not occur in the future that would once again justify vertical silos?"

Woroch adds, "Despite several compelling features, layered regulation fails to adhere to some basic principles of economic regulation that may, among other implications, defeat its pro-innovation goals. A minimum test for government intervention requires that the improvement registered over the unregulated outcome—derived from constraining the abuse of monopoly power, internalizing spillover effects, or pursuing social goals—is not overwhelmed by the costs of implementing the regulation."

Conclusion

The authors of this report highlight that there are a multitude of systemic problems when applying a network layers model to regulating current and future broadband networks. The most egregious deficiencies include:

(1) the model simplifies complex network interconnections,
(2) the model transfers the current regulatory model for traditional telecom networks to future broadband networks,
(3) it does not work economically and discourages technological innovation and network investment, and
(4) the network layers model ignores the benefits that vertical integration can provide for the industry and consumers.

Several authors suggest alternative strategies and make recommendations for letting free-market forces produce real competition or adhering to previously announced broadband principles such as those offered by the High Tech Broadband Coalition.

The authors of this report found that the network layers model was fatally flawed as a framework for new regulation or legislation. Many of the authors dismissed the MCI legislative proposal specifically because it does not provide a deregulatory path as envisioned by the Telecommunications Act of 1996. The authors conclude that the network layers model would be at cross-purposes with the Act's goals of promoting broadband growth, creating competitive markets, and benefiting consumers. The authors recommend a light regulatory touch or voluntary adherence to industry created principles to balance competitive concerns, while at the same time providing incentives for investment and innovation.

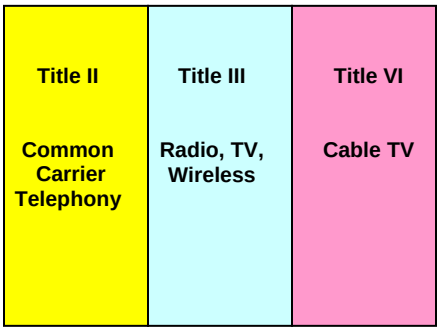
Regulatory reform is an important issue. The MCI layers approach highlights that. But it is an option which warrants a great deal more analysis and study.

Background

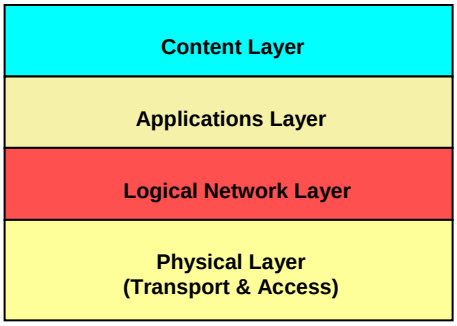
The Internet has changed the way we communicate by increasing the speed, the range of devices, and the platforms used to carry traffic. This is due to an open network architecture using the Internet Protocol, or IP, to transmit data across various networks in a different way than the way that signals travel on a circuit-switched network. Circuit-switched networks use dedicated resources along a path through the network for the duration of a call, while IP networks route traffic without requiring the establishment of a dedicated path. The IP network does not establish a permanent or exclusive path between the points but routes the packets depending on the best routing information available to the routers. The packets can carry any type of information for applications offering widely disparate functions, including voice communications.

Under the Communications Act of 1934, the Federal Communications Commission (FCC) has repeatedly modified and amended the existing regulatory regime to accommodate new services and technologies. Back then, Congress defined two categories of regulated entities and their corresponding services: common carriers regulated under Title II and users of the radio spectrum regulated under Title III. Services typically fit neatly into these categories because each service had discrete physical plant and readily identifiable service characteristics. Over time, however, providers offered new services that did not fit neatly into either category. For example, when cable services came along, which used wires for point-to-multipoint transmissions, the FCC decided that it would not treat cable as a Title II common carrier service. Congress then created a separate regulatory regime for cable under Title VI of the Act.

These "silos" are again being challenged by "information services" that do not fit neatly into the existing regulatory framework.



Current "Silos" Regulation



MCI "Layers" Proposal

In December 2003, MCI released, "A Horizontal Leap Forward: Formulating a New Public Policy Framework Based on the Network Layers Model," (Network Layers paper) by Rick Whitt, director of federal law and public policy. The paper advocates a move away from the traditional regulatory "silos" of communications regulation to a new "horizontal layers" concept based on the engineering design of the current Internet. MCI's paper is not new thinking as various experts (e.g., Kevin Werbach, Vint Cerf, Douglas Sicker, John Nakahata, and others) have written about the layered approach. MCI's paper proposes a set of layering principles built on the notion of "respecting the integrity of the layers." This framework encompasses both the "unregulated" e-commerce and e-business space, and the "regulated" telecommunications space. MCI's Layers Model conceptualizes four network layers – Physical Layer (with separate Access and Transport components), Logical Layer (IP), Applications Layer, and Content Layer.

The MCI Layers Model targets the lower network layers for regulation based on the existence of undue market power, rather than legacy service or industry labels. MCI claims this approach fosters maximum innovation by leaving the competitive content and applications markets unfettered by regulation. Thus, the Layers Model can help reveal, clarify, and resolve thorny issues related to the legal upheaval caused by the advancing IP world, MCI claims.

Scene Setting - Context of Why "Layers" Is Now Being Examined

In its early development under the Advanced Research Projects Agency Network (ARPANET) of the U.S. Department of Defense, the Internet was characterized as a horizontally layered and vertically stacked network. The "end-to-end principle," which became the central design principle of the Internet Protocol, posits that communications protocol operations should occur at the end-points of a communications system when possible.[2]

The proponents of the end-to-end principle argue that reliable systems tend to require end-to-end processing to operate correctly, in addition to any processing in intermediate systems. They also argue that end-to-end processing alone would be enough to make the system operate, and that the intermediate processing stages are largely redundant. This leads to the model of a "dumb network" with smart terminals, a completely different model to the previous paradigm of the smart network with dumb terminals such as the analog telephone system.

Engineers have developed several network design models incorporating communications protocols in a layered manner with slight variations depending on network needs. Transmission Control Program (TCP) and Internet Protocol (IP) were developed by a Department of Defense (DoD) research project to connect a number different networks designed by different vendors into a network of networks (the "Internet"). It was initially successful because it delivered a few basic services that everyone needed (e.g., file transfer, electronic mail, remote logon) across a very large number of client and server systems.[3]

Internet Protocol (IP) was introduced in 1974 and is limited in scope to provide the functions necessary to deliver a package of bits from a source to a destination over an interconnected system of networks. There are no mechanisms to augment end-to-end data reliability, flow control, sequencing, or other services often found in host-to-host protocols.[4] IP is composed of over 100 data communications protocols created to deliver bits over the network. Each protocol module usually communicates with two others so they are commonly imagined as *layers* in a stack of protocols. The lowest protocol always deals with "low-level" physical interaction of the hardware. Every higher layer adds more features. User applications habitually deal only with the topmost layers.[5]

TCP verifies the correct delivery of data from client to server. Data can be lost in the intermediate network. TCP adds support to detect errors or lost data and to trigger retransmission until the data is correctly and completely received.

Another layers model is the Open Systems Interconnection (OSI) Reference Model developed in 1978 by the International Organization for Standardization (ISO). The OSI Model includes seven embedded layers:

> Application Layer – This layer interfaces directly to and performs common application services for the application processes (e.g., electronic mail).
> Presentation Layer – Relieves the Application layer of concern regarding syntactical differences in data representation within the end-user systems (includes functions for basic encoding rules).
> Session Layer – Dialog coordination for managing the dialogue between end-user application processes. It provides for either duplex or half-duplex operation and handles application functionalities.
> Transport Layer – Reliable Data Transfer provides transparent transfer of data between end users, relieving the upper layers from any concern with providing reliable and cost-effective data transfer.

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[2] Jerome H. Saltzer, David P. Reed, and David D. Clark. End-to-end arguments in system design. *ACM Transactions on Computer Systems* 2, 4 (November 1984) pages 277-288.
[3] *Introduction to TCP/IP*, Howard Gilbert, Senior Research Programmer at Computing and Information Systems, Yale University, Feb. 2, 1995. http://www.yale.edu/pclt/COMM/TCPIP.HTM.
[4] Internet Protocol DARPA Internet Program Protocol Specification, September 1981, Information Sciences Institute, University of Southern California.
[5] http://www.encyclopedia4u.com/p/protocol-stack.html

Network Layer – ("Layer 3") Routing and Relaying - The Network layer provides the functional and procedural means of transferring variable length data sequences from a source to a destination via one or more networks. The router operates at this layer – sending data throughout the extended network and making the Internet possible.

Data Link Layer – ("Layer 2") Technology-Specific Transfer. The Data link layer provides the functional and procedural means to transfer data between network entities and to detect and correct errors that may occur in the physical layer. This is the layer that hubs and switches operate on.

Physical Layer – Physical connections provide major functions and services such as: (a) establishment and termination of a connection to a communications medium; (b) participation in the process whereby the communication resources are effectively shared among multiple users (*e.g.,* contention resolution and flow control); and, (c) modulation, or conversion between the representation of digital data in user equipment and the corresponding signals transmitted over a communications channel. These are the signals operating over the physical cabling – copper wires, coaxial cable, and fiber optics, etc. [6]

In the OSI Model, each layer only uses the functions of the layer below, and only exports functionality to the layer above. A system that implements protocol behavior consisting of a series of these layers is known as a 'protocol stack' or 'stack.' Protocol stacks can be implemented either in hardware or software, or a mixture of both. Typically, only the lower layers are implemented in hardware, with the higher layers being implemented in software. This logical separation of layers makes reasoning about the behavior of protocol stacks much easier, allowing the design of elaborate but highly reliable protocol stacks. Each layer performs services for the next higher layer, and makes requests of the next lower layer.

Layer	Examples/Standards
7 - Application	HTTP, SMTP, SNMP, FTP, Telnet, FTAM, APPC, X.400, X.500, Appletalk, AFP, DAP
6 - Presentation	TDI, XDR, SNMP, FTP, Telnet, SMTP, AFP
5 - Session	NWLink, NBT, Named Pipes, NetBIOS, ASP, ADSP, ZIP, PAP, DLC
4 - Transport	TCP, UDP, SPX, NetBEUI, ATP, NBP, AEP, RTMP
3 - Network	IP, IPX, NWLink, NetBEUI, DDP
2 - Data Link	Ethernet, Token Ring, PPP, ODI, NDIS, LocalTalk, TokenTalk, EtherTalk
1 - Physical	RS-232, ISDN, 10BASE-T, electricity, radio, fiber optics
The OSI "Seven Layer" Model	

Like the TCP/IP suite, the OSI Model is layered to segment discrete functional responsibilities. Each layer represents a function performed when data is transferred between cooperating applications across the network. In the resulting vertical hierarchy, the content begins at the top layer and works down to the lower physical layer for transport to the ultimate destination, where it then ascends back to the top layer again.

In addition to standards for individual protocols in transmission, there are now also interface standards for different layers to talk to the ones above or below (usually operating-system-specific). For example: Winsock and Berkeley sockets between layers 4 and 5, or NDIS and ODI between layers 2 and 3. In real-world protocols, there is some argument as to where the distinctions between layers are drawn and there is no one correct answer.

[6] http://www.encyclopedia4u.com/o/osi-model.html

Genesis of the Layers Policy Model

In September 2000, independent technology analyst and consultant Kevin Werbach introduced the idea of using the engineering basis of the Internet as the basis for policy development in a paper titled, *A Layered Model for Internet Policy*. Werbach wrote, "rather than mechanically applying outmoded categories to novel converged services, regulators should reformulate communications policy with the Internet at the center…the best place to start is with the technical architecture of the Internet itself, which differs in important ways from that of traditional telecommunications and broadcast networks." He also added that, "different policy approaches should be used for each layer, and regulators should turn their attention from pricing to the openness of interfaces between layers and competing services."[7]

This was the beginning of the layers movement as a potential policy vehicle. Werbach pared down the OSI Reference Model into four layers for regulatory purposes: content, applications or services, logical, and physical. "Layering means that higher-level functions, such as content presentation, are defined separately from lower-level ones such as congestion buffering and traffic routing," wrote Werbach. "A consequence of layering in an end-to-end environment is that Internet services can be moved up or down the stack as necessary. IP telephony, for example, takes a service - voice - previously delivered at one level and recreates it at a higher level on top of an Internet data stream." He notes that regulation has focused most heavily on the physical layer, particularly when that layer could exert market power into other layers.

The layered model doesn't necessarily require wholesale changes in existing rules. His paper attempted to outline frameworks and highlight issues, rather than propose specific policy outcomes. He posits that a layered model makes many of the conflicts that today bedevil regulators more tractable. For example, "the inconsistency between the treatment of DSL, which is subject to federal open interconnection requirements (under Title II), and cable modem services, which currently are not, turns out to be a figment of the horizontal model. Both cases involve the possibility that service providers with control over the physical and logical layers of networks will extend that control into applications and content. Looking at the issues in this way doesn't compel one outcome or the other. It may be that the FCC concludes open access is the right policy result, but that in the cable situation market forces will be sufficient to arrive at that result. The important shift is that the focus is now on the key policy issue at stake, rather than the almost accidental context that defines the issue today," Werbach writes.

A number of other scholars have embraced and expanded on the layers approach.[8] Frieden assesses the viability of different vertical regulatory regimes, comparing the U.S. and European Union regulatory histories, in an increasingly convergent environment and explores whether a horizontal regulatory approach can reduce the number of regulatory asymmetries and inconsistencies. Frieden concludes that while a horizontal regulatory structure may not secure sufficient political support because of the risk of extending new burdens on previously unregulated activities, that type of structure makes better sense in a convergent, increasingly Internet-dominated marketplace.

Sicker examines the suitability of the layered model and writes, "The consistency and modularity of such an approach may be a workable alternative to the current title-based policy. However, a layered model in and of itself is

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[7] *A Layered Model for Internet Policy*, Kevin Werbach, September 2000 Draft, available at http://www.edventure.com/conversation/article.cfm?Counter=2414930.

[8] *See* Douglas Sicker, Joshua Mindel, & C. Cooper, *The Internet Interconnection Conundrum* (1999) (unpublished FCC working paper); Douglas Sicker, Joshua Mindel, *Refinements on a Layered Model for Telecommunications Policy*, Silicon Flatirons Journal (2002); Jonathan Weinberg, *The Internet and Telecommunications Services, Universal Service Mechanisms, Access Charges and Other Flotsam of the Regulatory System*, Telecommunications Policy Research Conference (1998); François Bar & Christian Sandvig, *Rules From Truth: Post-Convergence Policy for Access*, TPRC Paper (2000); Mark A. Lemley, Lawrence Lessig, *The End of End-to-End: Preserving the Architecture of the Internet in the Broadband Era,* Stanford Law School, Working Paper No. 207 (2000); Rob Frieden, *Adjusting the Horizontal and Vertical in Telecommunications Regulation: A Comparison of the Traditional and a New Layered Approach,* Federal Comm. Law Journal (March 2003).

insufficient." He notes that a layered model must reflect the reality of network design and business arrangements and requires a transition policy to get there from the existing policy regime. "The ultimate point is that policy issues at one layer are not the same as policy issues at another. This model does not purport to eliminate the regulatory disparity among all providers of communications services; in fact, we believe that there is sound reason to treat providers with market dominance differently from providers without. What this model does provide is a framework that will allow the services riding over the network to be treated independently from that network. This consistency may actually mean new regulatory obligations for some providers, so as to ensure such things as interconnection and emergency services," he concludes.[9]

As scholars began to build on this early research on a layered model for regulatory purposes, certain elements of the layered approach appealed to various industry sectors. The policy debate on the layers approach started in the telecom industry when Richard Whitt, senior director of global policy and planning for MCI, adapted the layered approach as a policy framework applicable to the new communications networks of the future that will be based on the engineering concepts of Internet Protocol and similarly engineered networks.[10]

Transition to Proposed Public Policy - 'MCI paper' Advocating New Regulatory Scheme

MCI's proposal focuses on the notion of "respecting the integrity of the layers," for both the unregulated e-commerce and e-business space, and the regulated telecommunications space. MCI's model considers four network layers including: Physical Layer (with separate Access and Transport components), Logical Layer (Internet Protocol), Applications Layer, and Content Layer. MCI claims that its proposed framework can achieve important policy objectives including: avoiding unsupportable legacy distinctions between services, networks, and industries; appropriately separates upper layers (user applications and content) from lower layers (physical and logical networks); providing insights about the interdependence of different layers; highlighting interconnection between networks and functional layers; focusing selectively on curtailing pockets of market power within and between individual layers; and preserving the "innovation commons" of the Internet.[11]

MCI's proposal relies heavily on the work of Professor Lawrence Solum of Loyola Marymount University, in which he lays out the key concepts in supporting a layered approach to telecom regulation.[12] Solum's "layers principle" is embodied in the following statement:

> Public regulators should not adopt legal regulations of the Internet (including statutes, regulations, common law rules, or interpretations of any of these) that violate the integrity of the layered nature of Internet architecture, absent a compelling regulatory interest and consideration of layer respecting alternatives.[13]

Solum then proposes two corollaries to support his layers principle. First, corollary one (the principle of layers separation) says, "Regulation should not violate or compromise the separation between layers designed into the basic infrastructure of the Internet, so that one layer of the Internet would differentiate the handling of data on the basis of information available only at another layer, absent a compelling regulatory interest." Corollary two (the principle of minimizing layer crossing) says, "If compelling regulatory interests require a layer-crossing regulation,

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[9] Douglas Sicker, *Further Defining A Layered Model For Telecommunications Policy,* Telecommunications Policy Research Conference (2002).
[10] A HORIZONTAL LEAP FORWARD: Formulating A New Public Policy Framework Based On The Network Layers Model, An MCI Public Policy Paper, Richard S. Whitt Senior Director of Global Policy and Planning MCI (March 2004).
[11] Id. at iv.
[12] Lawrence B. Solum and Minn Chung, *The Layers Principle: Internet Architecture and the Law*, University of San Diego School of Law, Public Law and Legal theory Research Paper No. 55 (2003).
[13] Id. at 29.

that regulation should minimize the distance between the layer at which the law aims to produce an effect, and the layer directly targeted by legal regulation."[14]

MCI then adds two of its own corollaries as it would apply them to traditional common carrier regulation. Corollary three (the principle of leveraging lower layer control) states, "The ability of a private actor to employ market power at the lower Physical Layer allows that same entity to leverage market power into the higher layers that depend on the Physical Layer. In essence, he who controls the lower layers also can control the dependent upper layers." Finally, corollary four (the principle of focusing regulatory attention) states, "Regulators should target necessary legal and regulatory resources only to those specific horizontal layers where market power resides, or where regulatory attention otherwise is necessary in the public interest, and leave the remaining horizontal layers free from unnecessary regulatory constraints."[15]

The MCI Layers Model targets the lower network layers for regulation based on the existence of presumed undue market power, rather than legacy service or industry labels. MCI claims this framework promotes innovation by leaving the content and applications markets unfettered by regulation. "The MCI Layers Model can help reveal, clarify, and resolve thorny issues related to the legal upheaval caused by the advancing IP world," MCI writes.

[14] Whitt at 27.
[15] Whitt at 44, 47.

Introduction: The Layered Regulation Policy Model

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How should the Internet – and the network that supports it – be regulated? That is the question facing regulators as new technologies and services change the face of communications. One thing is certain: the hodge-podge of rules and regulatory classifications now in use is increasingly ill-suited to the 21st Century's evolving digital networks. But what should replace it? Over the past few years, a number of academic and industry analysts have proposed what they call a "layered" approach to regulation, tracking the structure of the Internet itself. This new approach, however, may simply replace one set of problems with another, and itself hinder the growth of the Internet.

The current regulatory system for communications was constructed piecemeal over the past 70 years. To a large degree, regulation is based not on function or market structure, but on the technology used. Under the current system telephone companies are regulated by federal and state authorities as common carriers; while cable networks are considered private systems and are regulated by local franchise authorities. Providers using wireless technologies are subject to yet another set of rules, largely under the control of the Federal Communications Commission. Other parts of the Internet – such as Internet Service Providers are regulated far less intensively, although they are subject to antitrust and other rules.

The system, whether or not it ever made sense, is quickly breaking down. Regulators often treat firms providing essentially the same services completely differently. Cable firms, telephone companies, and wireless companies, for instance, provide high-speed Internet access, but their operations may be subject to completely different regulatory schemes.

Moreover, regulatory classifications themselves can be difficult or impossible to meaningfully assign. For instance, for years courts and regulators have struggled over whether to classify high-speed Internet access over cable systems as a "telecommunications" service rather than a "cable" service. The resulting regulation would be vastly different under each. The distinction is purely a legal one, however – to the consumer, the service is the same. As a result, the debate often takes on an Alice in Wonderland quality, with lawyers arguing over words that have no anchor in reality.

The problems have become apparent in other contexts as well – most notably with the advent of "voice-over-Internet-Protocol" or "VOIP" telephone service. VOIP provides consumers with the same voice communications as a standard telephone call, yet is transmitted over the Internet just like an e-mail. Should it then be regulated like telephone service? Or like just another Internet application?

In light of these problems, a number of analysts have proposed an alternative, known as layered regulation. The concept of layers comes from the structure of the Internet itself. At the core of the Internet is a "dumb pipe" which carries bits of information from one point to another. The first "layer" on this dumb pipe includes the software protocols related to the physical interaction of hardware and the data transmitted. Using these basic protocols as building blocks, subsequent protocols are "layered" on to the system, each providing more and more functionality. Each layer depends on the lower layers to operate, and in turn performs services for higher layers. Users typically only work with the very highest layers such as those that provide services such as e-mail. One advantage of this system is that protocols at one layer can be revised or replaced without wholesale changes to the entire network.

In 2000, technology analyst Kevin Werbach proposed using the concept of layers as the basis for regulation of the Internet and telecommunications.[1] Instead of regulating "vertically" – i.e. by service or technology – he argued that regulation should be applied "horizontally", i.e. based on what layer of the Internet is involved. He proposed that four discrete layers of the Internet be recognized for regulatory purposes:

1) Physical – the underlying networks, such as copper, cable, fiber optic, and satellite infrastructure;
2) Logical – the management and routing functions that keep information flowing, such as the telephone numbering system and the domain name system;
3) Applications – Internet access, IP telephony, video programming, and other end-user functions;
4) Content – the actual information delivered to and from users.

Each of these layers would be regulated according to their specific characteristics. He did not specify what kind or extent of regulation would be appropriate for each layer, even holding out the possibility that activities *within* a specific layer could be regulated differently. He stated that the key was not the specific result, but the use of layers as an analytical tool.

To that extent, the concept of layering – at the theoretical level – is relatively uncontroversial. Who can oppose the idea of basing regulation on the structure of the communications system rather than on outdated service definitions? Yet, the idea – especially as elaborated upon by subsequent analysts – does have some very specific implications for policy.

One of the most extensive and recent elaborations of how layered regulation could work is a paper authored by Richard S. Whitt of MCI earlier this year.[2] Whitt identified a number of public policy implications of a layering approach. These include:

- Avoiding IP layer regulation aimed at content layer problems. He cites a recent Pennsylvania law that allows courts to order ISPs to block access to specific URLs deemed to be pornographic. Whitt would also apply this rule to private actions – citing attempts by certain ISPs to block access to peer-to-peer sites such as KazaA.
- Requiring regulators and providers to respect layer divisions. For instance, he cites the recent attempt by Verisign to re-direct mistyped URL addresses to a site operated by Verisign itself.
- Mandating open interfaces and interconnection, both between layers and between players in the same layer.
- Limiting the leveraging of market power in one layer to gain power in another. Whitt specifically argues for continued requirements for telephone companies to unbundle network elements.
- Limits on vertical integration. Whitt argues that allowing vertical integration, especially where one player has market power, is an invitation to abuse, limiting opportunities for competition in other layers. He specifically calls for limits on "closed" networks, which limit entry of independent operators at other levels. He cites the establishment of closed broadband networks by cable firms, thus excluding other ISPs, as an example.

Each of the policy recommendations, however, raises significant questions. For instance, while avoiding content restrictions may be appropriate, is that because of layering theory or because of existing free speech principles? The fact that it also violates layering principles seems almost trivial by comparison.

The principles of open access and limits on vertical integration, key to the layering concept, raise more troubling questions. Could open access dilute incentives to invest, as well as make integration of services more difficult, to

[1] Kevin Werbach, A layered model for Internet policy, Journal of Telecommunications and High Technology Law (2002). A Sept. 2000 draft is available at http://www.edventure.com/conversation/article.cfm?Counter=2414930.
[2] Richard S. Whitt, "A Horizontal Leap Forward: Formulating A New Public Policy Framework Based on the Network Layers Model," An MCI Public Policy Paper (March 2004).

the detriment of consumers? Economists have long recognized vertical integration as a key to efficiency and progress in many markets. Instead of benefiting consumers, would limiting such integration make cost cutting more difficult, hurting consumers? Moreover, would such limits freeze into place current layer structures, preventing the network from evolving? This could be especially critical in dynamic markets where services and technologies are changing. Would we simply be exchanging one system of arbitrary regulatory categories for another?

Lastly, the Whitt policy proposals seem to assume that many providers, such as telephone companies have undue market power. But is this assumption warranted, given the number of competing providers offering this service? Moreover, do such conclusions flow from layering theory? Or does this simply re-hash long-standing debates over telephone competition in a new guise?

Certainly, the current regulatory system for Internet communications needs reform. But is layered regulation the answer? Is it part of the answer? Or would it be a step backward? The essays that follow address these and other issues.

Up, Down, Across – It's Still Regulation

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In the wake of the recent District Court of Appeals decision rejecting critical components of the FCC's Triennial Review Order, uncertainty in the telecommunications sector has risen dramatically.[3] Those wishing to preserve the status quo—a system of open access at regulated rates—are urging an appeal to the Supreme Court, while those wishing to move towards a model of market-based competition are calling for commercial negotiations to replace the failing regime of managed competition. Adding to the confusion is a renewed interest in "layered regulation" as an alternative that seeks to promote competition and innovation while targeting regulation to limit market power. Unfortunately, this approach would continue to impose regulatory impediments that inhibit critical infrastructure investment and limit growth in the telecommunications sector.

The layered approach recognizes the failures of the existing regulatory paradigm in the face of converging technologies. In a market where voice, data, and video have converged into a more general demand for information, it makes little sense to regulate separately wireline, wireless, cable, and satellite services based upon the products they were initially established to provide. In an open market, all of these technologies will compete to provide consumers the products they demand; regulations that artificially segregate and divide markets unnecessarily restrict market activity and reduce consumer choice.

While the layered model acknowledges the problem of regulating cutting edge technologies with legacy regulations crafted before many of today's applications even existed, it offers little to ease the current regulatory impasse. In fact, the current problems that plague the telecommunications sector would persist, if not intensify, in a new regulatory model based on network layers. A more prudent solution to today's problems would encourage capital investment and the facilities-based competition envisioned in the 1996 Telecommunications Act.

The Basic Layers Approach

The network layers approach is viewed as an alternative to the current regulatory regime of vertical silos, which treat wireline, wireless, cable, and satellite services independently, with specific regulatory mandates for each provider and scant recognition of intermodal competition between providers. Thus, while wireline and cable providers offer similar services and compete for the same customers, wireline remains heavily regulated while cable regulation has been specifically rejected by the FCC.

The most thorough presentation of a new layered model of competition was prepared by Richard S. Whitt for MCI.[4] The Network Layers model envisions four layers—content, applications, logical, and physical—with most regulation reserved for the deepest layer which is the physical connections that comprise the network, including the wireline, wireless, cable, and satellite services that transport information. The physical layer, in essence, would become simply a regulated transport provider, with additional steps taken to ensure that monopoly power is not leveraged into activities that take place in higher layers. Vertical integration would be prohibited or severely restricted.

The network layers model seeks to replace ill-suited legacy regulations with a new regulatory framework that is more compatible with the convergence of voice, data, and video transmission that is currently underway. Instead of

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[3] *United States Telecom Association v. Federal Communications Commission*, U.S. Court of Appeals for the District of Columbia, March 2, 2004, available at http://pacer.cadc.uscourts.gov/docs/common/opinions/200403/00-1012b.pdf

[4] Richard S. Whitt, "A Horizantal Leap Forward: Formulating a New Public Policy Framework Based on the Network Layers Model," An MCI Policy Paper, March 2004, available at http://global.mci.com/about/publicpolicy/presentations/horizontallayerswhitepaper.pdf.

independent regulations for various service providers (wireline, wireless, cable, and satellite), the regulatory framework would be adapted to the various layers of telecommunications services. The wires, switches, and cables that move information would be regulated to limit market power and ensure access that allows consumers and content providers to exchange information provided on the higher levels. This physical layer would be further divided into last mile access regulations and Internet backbone regulations. The logical layer, which is just above the physical layer, is the code, or architecture, of the network, such as IP and other protocols, and would engender its own regulations. Above this is the application layer, which is the software that provides users an interface, such as e-mail or a web browser. The final layer is the content layer, which provides the information viewed on the web page, or the video or data stream relayed to the end user.

The layers model raises a number of important issues at all levels, from ownership and access at the physical layer, to debates over open architecture at the logical level, to questions of intellectual property rights at the application and content levels. Indeed, the regulatory regime would need to address virtually all the regulatory issues that currently are before the FCC, from UNE-P access to media diversity. Discussion in this paper, however, will be limited to an examination of regulation of the physical layer upon which the entire network layer model rides.

Smarter Regulation?

Proponents of the layers model suggest that it offers a smarter approach to regulation that ensures a robust and competitive market for content and applications while limiting regulation to cases of excessive market power. In particular, this seems to suggest relegating the physical transport layer, especially the last-mile connections to consumers, to a world of regulation. As Richard Whitt notes, "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 most end users, including single-family residences, small businesses, as well as large businesses in less densely populated areas."[5]

Yet in today's telecommunications market, entry at this level does occur, and the introduction of VoIP will only increase the competition. Wireline is already losing customers to wireless and cable providers, and cable providers are losing market share to satellite providers. To suggest that this physical layer must, in all likelihood, remain regulated is to ignore the current market realities of intermodal, facilities-based competition. As Thomas Hazlett describes these dynamic markets, "All feature entry by companies that own their own infrastructure and now steal customers from the 'natural monopolies' that preceded them."[6]

To be sure, proponents of the layered model claim the regulatory burden on the physical layer would be eased in the absence of market power. However, it is unclear how the physical layer would be able to change if it is initially locked into a static vision of transport based on current conditions. As has happened elsewhere in the telecommunications sector, a regime of regulated prices can drive investment out, leaving few players with the incentives or resources to invest in the physical layer. Consequently, open market competition could be replaced with increased rent-seeking behavior and politically established rates for the use of physical infrastructure.

Perhaps the most troubling aspect of the layered approach outlined by MCI is the fact that it makes no effort to address problems imposed by the UNE-P. Despite the fact that the UNE-P is at the very crux of the current regulatory crisis in telecommunications, it is viewed as "…an important legal mechanism in service of the layers principle."[7] Rather than eliminating the UNE-P or revisiting the TELRIC pricing formula, it is viewed as "an interesting blend of horizontal and vertical thinking" necessary for promoting intramodal competition.

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[5] *Ibid.*, p. 35.
[6] Thomas Hazlett, "The Irony of Regulated Competition in Telecommunications," *Columbia Science and Technology Law Review*, vol. IV, 2003, available at www.stlr.org.
[7] *Ibid.*, p. 45.

This view ignores the fundamental problem facing the telecommunications sector in the wake of the high-tech bubble. Namely, the current market provides no incentives to invest in critical infrastructure. The Competitive Local Exchange Carriers (CLECs) find it cheaper to lease equipment at regulated rates, and have abandoned investment in favor of UNE-P access. For example, in December 1999, CLECs relied on UNE access for 24 percent of their lines, while 33 percent were CLEC owned. As of December 2003, CLECs reported providing about 16 percent of their switched access lines by reselling the services of other carriers and about 61 percent by means of UNEs leased from other carriers. The remaining 23 percent of CLEC lines were provided over local-loop facilities owned by the CLECs.[8]

At the same time, the Incumbent Local Exchange Carriers (ILECs) have no incentive to invest in new infrastructure that they must lease to their competitors at rates that do not allow costs to be recovered. Consequently, broadband deployment by ILECs has been slow relative to less regulated providers. Cable companies, which are not subject to open access mandates, have become the dominant providers of broadband, outpacing DSL providers by a 2-to-1 margin. With VoIP bringing voice communications to broadband, cable will expand even further, providing additional competitive pressure at the physical level.

Vertical Lines in the Sand

Beyond a regulatory framework that continues the current regime of open access, the network layers model also includes prohibitions on vertical integration in an attempt to keep monopoly owners of the physical layer from exerting market power in the upper layers, such as applications or content. This proposition is problematic for a number of reasons, beginning with the assumption of monopoly power on the part of the physical layer providers. As noted above, wireline and cable companies compete vigorously at the physical level. Advances in wireless and satellite technology, as well as the potential for broadband over power lines, will only enhance competition and expand consumer choice when it comes to selecting a conduit for broadband.

The proposed ban on vertical integration also threatens economic efficiency in higher layers as well, such as applications and content. For many reasons, from reducing transactions costs to internalizing externalities, vertical integration can be efficient. More than most sectors of the economy, telecommunications and technology are best described as dynamic and rapidly evolving markets. To arbitrarily restrict vertical integration may unnecessarily limit the development of the broadband networks required to provide the video and data content consumers demand.

Moreover, as technology develops, it is not necessarily following the prescripts of the network layers model. There may, indeed, be valid economic and technological reasons for bundling applications or integrating between layers. Allowing businesses to compete in an open market is the best way to identify what combinations of capital can provide consumers the products and services they demand. Adopting another system of arbitrary boundaries, on the other hand, may inhibit innovation while restricting the flow of capital required to build a broadband network.

Conclusion

In the end, it is puzzling that the network layers model would be considered much of an improvement. It does take the important step of abandoning the old functional silos that have governed the telecommunications and technology sectors for the past century. Yet the core problems with the old system remain. The UNE-P determines access and continues to drive incentives to invest (or not invest) in the physical infrastructure. And while the silos may be gone, the new horizontal layers may be just as chafing in a matter of time, with prohibitions on integration across layers reducing innovation and investment. Since the onset of intermodal competition, advocates of open and competitive markets also have sought to eliminate regulatory silos. But instead of a new system of regulation, they envision

[8] Local Telephone Competition: Status as of December 31, 2003, Industry Analysis and Technology Division, Wireline Competition Bureau, FCC (June 2004).

competition and market forces guiding the development of broadband. The network layers model does not share this vision; it continues to rely on the worst of the old model while establishing a new regulatory framework that will continue to hinder broadband deployment.

MCI's Layered Approach: A Horizontal Leap Nowhere

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A new policy framework by MCI recommends a paradigm shift in telecommunications toward regulation based on how the Internet operates.[1] MCI has even gone as far as drafting proposed legislation to codify its approach.[2] Dubbed the "Network Layers Model," MCI's proposal builds upon an academic movement that has been gaining increasing visibility due to the obvious need for telecommunication regulatory reform. Rather than regulate by service categories, the network layers approach utilizes the structure of the Internet as the model for deciding what and how to regulate.

On its face, the layers model is a seductive analytical tool that improves upon the current lack of cohesiveness in telecom regulation. It breaks down policy goals by network layers – physical, logical, application, and content – and advocates for regulation that is specific to each, regardless of the technology used or service provided. However, what is a superior analytical tool for network engineers is not necessarily good for network regulators. The layers model does not translate to effective public policy because it is burdened with the same regulatory traps of current law – it retains too much faith in the capability of government regulators to beneficently intervene in the market. In particular, it places an inordinate amount of emphasis in antitrust law to improve consumer welfare and it ignores the reality of how markets respond to consumer demand and preferences. Under MCI's proposal, the physical network is at the same time overburdened and underappreciated by regulation.

The Network Layer as FCC, DOJ, and FTC Playground

The layers model assumes that the physical network is a natural monopoly that requires extensive regulation. In this way, the layers model is, as MCI's policy paper asserts, "not a radical departure from the basic regulatory structure and precedent of the last four decades."[3] Indeed, this is a problem, though the paper presents this as a positive. The difficulty is one of defining "market power" and how to test for its existence.[4] Antitrust law has not been very good at solving this problem, as much as its proponents would like to proclaim that it has. Defining the "relevant market" for antitrust purposes is as much of an arbitrary process as the current silo service definitions are for telecom law.

The fundamental goal of the layering principle is to "focus on where the concern lies…and then determine how best to achieve the goal without disrupting other layer-affecting objectives."[5] The overriding concern of MCI, as expressed in both its policy paper and draft legislation, is in the network layer. Indeed, the bulk of the MCI's draft text consists of a section on broadband access platforms competition, which is none other than the broadband equivalent of the Unbundled Network Element (UNE) system currently in place for "traditional" telecom. And it seems to guarantee that changes in technology will affect changes in law without the concomitant assurance that government regulations will change quickly, if at all.[6]

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[1] Richard S Whitt, *A Horizontal Leap Forward: Formulating a New Public Policy Framework Based on the Network Layers Model*, (March 2004).
[2] Richard S Whitt, *Codifying the Network Layers Model: MCI's Proposal for New Federal Legislation Reforming U.S. Communications Law*, (March 2004).
[3] *A Horizontal Leap Forward* at 22.
[4] Id. At 21. The policy paper admits that one of the "lingering questions" include "devising empirically-based tests for market power and monopoly abuses".
[5] *A Horizontal Leap Forward* at 63.
[6] Id. at 28, 29 (stating the view of Professor Lawrence Solum of Loyola Marymount University that legal regulation "can only be as effective as is permitted by the architecture of the Internet" and that "the layers principle is only as valid as the network engineering concepts that inform it").

Layer Regulation Will Not Necessarily Increase Consumer Welfare

The layers model cannot translate to effective public policy because it mandates a business model. Cable or telephone companies may in the future wish to establish "closed" networks, and doing so may indeed be within the interests of consumers. Peter Huber presciently asserted in 1987 that "as networks expand horizontally the companies that manage them grow vertically" in response to consumer demand for a single provider of integrated service packages.[7] A portion of this vertical development may be in response to the needs of a provider to effectively price differentiate in an industry affected by declining marginal costs.[8]

The layers model invites overly ambitious regulatory scrutiny when a technology provider attempts to operate within more than one layer. Often, tying applications to network infrastructure may be the only way to pay for the network. A critical question is whether the network is financially viable based on connectivity revenues alone. Price discrimination is often an effective (albeit misunderstood) way to increase consumer welfare. It may be necessary to meter consumer usage by measuring intensity of use at one layer through controlling another layer. Market segmentation may require multiple layer control, depending on what consumers value and are willing to pay.

Advances in technology often result in the increasing commoditization of products, resulting in increased consumer welfare. Regulators should focus on ways that will allow providers of commoditized products to thrive, instead of saddling them with "open access" and "common carrier" burdens. A new telecom act must protect the ability of telecom providers to quickly respond to and operate within a dynamic environment. However, the layers model may be just as rigid as current law in allowing the market flexibility in pricing and service, especially at the network level. The MCI paper quotes Lawrence Lessig and Timothy Wu at an FCC hearing:

> If this 'Darwinian evolution' is the best path of innovation, it follows that the most promising path of development will be difficult to predict in advance. Hence, despite the 'waste' generated by a competitive process, the results will be superior to planned innovation directed by a single prospect holder, however well-intentioned.[9]

The largest "prospect holder" under the layers approach is the FCC. This is not a horizontal leap forward for the telecommunications market or consumer welfare.[10]

The MCI Draft Legislation – A Regulatory Wolf in Layered Sheep's Clothing

MCI has outlined its version of what a reformed Communications Act should look like. MCI calls it "The Internet Innovation and Broadband Competition Act of 2004" yet it is very similar to the 1996 Telecommunications Act. The Basic/Enhanced distinction is now Layer 1 (Physical) versus Layer 3 and 4 (Application/Content). The proposed legislation is semantic re-regulation. For instance, is Active X control content or code? It doesn't make much of a difference under MCI's current construct, but one can envision the technical definitional matters that a court of law might have to decide and the problems that this would create. Engineers would replace economists in the battle of expert witnesses.

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[7] *The Geodesic Network*, 1987 Report on Competition in the Telephone Industry, United States Department of Justice, (1987).
[8] The controversy surrounding industries affected by high fixed and relatively low operating costs continues. *See* Ronald Coase, *The Marginal Cost Controversy*, 13 (New Series) Economica 169, 169 (1946) *and* Jim DeLong, *Marginalized*, Tech Central Station, (July 29, 2003) available at http://www.techcentralstation.com/072903D.html
[9] *A Horizontal Leap Forward* at 32.
[10] Artificially low wholesale prices for telecommunications services required under current federal unbundled network element (UNE) and platform (UNE-P) rules end up costing Americans substantially more than what would be the case in the absence of such regulations. *See* Stephen B. Pociask, *The Effects of Bargain Wholesale Prices on Local Telephone Competition: Does Helping Competitors Help Consumers?*, (June 2003) *available at* http://cei.org/pdf/3529.pdf

An analysis of MCI's draft legislation reveals that (italicized emphasis added):

- Broadband networks will be subject to continuous and pervasive FCC regulation according to ambiguous standards such as:

    - "the FCC *shall* adopt rules and regulations necessary to further foster the development of intramodal and intermodal competition, *to the benefit of all Americans*.

    - Waiver of open access requirements upon "no further evidence of *market power* or other *relevant* standard and/or at least three other *commercially-viable competing* broadband access platforms serve a *substantial* majority" or if the platform provider can demonstrate that end users are able to *fully exercise their Internet access rights;*

- Antitrust principles are given prophetic status: antitrust law will play an unprecedented role in telecommunications, using the imprecise Herfindal-Hirschman Index (HHI) and other forms of "anticompetitive practices demonstrating the existence of market power";

- Property rights get no respect: unbundling and price regulation remain by way of extensive wholesale carriage requirements for ISP access, CLEC unbundled access to broadband local loops at TELRIC prices; and

- A new subsidy program for broadband and wiretapping access of all Internet communications will invade consumers' wallets and privacy.

Conclusion

Layered model advocates believe that regulators should reformulate communications policy with the Internet at the center. Instead, what we should be discussing is how to change communications policy so that market forces, instead of government regulators, affect consumer welfare. The *free market* should be at the center. Ultimately, we want to reduce the role of the FCC in micromanaging the market for communications products and services. The layered model will not lead us toward this deregulatory path. Simply put, *layering is an object-to-think-with but not a model-to-regulate-with.* The layers principle may excel at respecting the integrity of TCP/IP, but it fails at respecting the integrity of market forces.

Feasibility Issues Inherent in the "Layers" Model for Internet Public Policy

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"Trojans, trust not the horse. Whatever it be, I fear the Greeks, even when bringing gifts."
The seer Laocoon 2 to the people of Troy[1]

Considerable discussion has focused on the "Layers Model" of the Internet as a potential foundation for Internet public policy. In its white paper espousing this model, MCI says:

> *"Well-founded on fundamental engineering principles, and buttressed by economic analysis, the layers principle, as expressed in this paper's notion of a horizontal layers framework, should be adopted by policymakers as a necessary and productive public policy tool."* [2]

MCI is not alone in its enchantment with a "Layers" approach. It has been proposed and promoted in various forms by a number of telecommunications pundits, including academics Lawrence Lessig, Lawrence Solum and Minn Chung, Kevin Werbach, Philip J. Weiser, and Douglas Sicker.

Like the wooden horse of Troy, however, this promotion of the "Layers Model" has a hidden agenda – the perpetuation and expansion of legacy telephone regulation to all forms of Broadband Internet in a form that would give a small handful of nevertheless large companies a powerful competitive advantage in the marketplace. It is less a productive policy tool than a blunt competitive weapon to be used against MCI competitors and suppliers:

> *"In particular, the MCI Layers Model targets the lower network layers for regulation based on the existence of undue market power, rather than legacy service or industry labels."*[3]

The "Layers Model" is neither new nor innovative. It is, in fact, an effort to dress up in new language the failed competition policies that were put into place in the wake of the Telecom Act of 1996 – policies that have stymied investments in telecommunications infrastructure; inhibited the deployment of broadband services in the United States; and created a new class of favored and entitled companies that FCC Chairman Michael Powell describes as "competitors on life support."[4]

Inherent Problems of the "Layers Model"

There are any number of facets of the "Layers Model" that are problematical to its use as a foundation for Internet public policy. But the following are serious enough to call the model into question:

- **The model doesn't accurately represent the Internet.** At best, the model is a gross simplification of the elements that make up the Internet, with no appropriate reference to how those layers interact or relate. Moreover, there are no Internet service providers in the United States who operate only in one layer. All ISPs operate in

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[1] Virgil, the Aeneid, 2.48
[2] Richard S. Whitt, "A Horizontal Leap Forward: Formulating a New Public Policy Framework Based on the Network Layers Model," *MCI Public Policy Paper*, Version 1.0, December 2003, http://global.mci.com/about/publicpolicy/presentations/horizontallayerswhitepaper.pdf
[3] Ibid.
[4] Separate Statement of Chairman Michael K. Powell, Dissenting in Part, Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers (CC Docket No. 01-338), August 20, 2003.

multiple layers, providing their own unique mix of content, services, applications, transport and access services – including MCI. While ISPs may differ widely in terms of the layers in which they participate – some offering access and content but not their own network, and some offering only network services but no applications or content – it is not possible to divide any single Internet company into clearly delineated and unrelated layers.

- The model "criminalizes competition." As defined by MCI and others, the goal of the model is to punish competitors that have "undue market power." The term "undue" is not defined, but may be presumed to mean any competitor that has more market power than MCI. In point of fact, in open and competitive markets it is the goal and obligation of every competitor to amass and maintain market power. There is nothing illegal in doing so unless U.S. antitrust laws are broken, which is in any event the concern of the U.S. Department of Justice, not the FCC. Punishing competitors simply because they invest more, compete more, assume higher risk, or are more efficient is an unwarranted abuse of regulatory authority.

- The model fragments the Internet industry. A regulatory regime that artificially erects barriers between layers, and that punishes competitors for being successful, makes it impossible for companies to amass sufficient market share to emerge as industry leaders. This has been the case in the Internet industry, which today has no clear leaders and little cohesion. Without such cohesion and leadership, the Internet industry cannot continue to grow, mature, and thrive.

- The model is a disincentive for investment in Internet infrastructure. Unfettered by regulatory barriers and the imposition of faux competitors, companies engaged in cable, wireless, and satellite broadband have invested hundreds of billions of dollars in broadband infrastructure. The same is not true in the markets for DSL, where the requirement for telephony companies to share their assets at lower-than-market cost has introduced uncertainty and disfavor to investments. The use of the Layers Model would expand this uncertainty and disfavor to all Internet companies that operate in the Physical Layer – expanding the damage of over-regulation rather than repairing it.

- The model inhibits rural deployment of broadband. Deployment of broadband into rural areas requires a robust set of competitors that can afford to bear the cost of building out infrastructure, can amortize that investment cost over a longer period to offset lower initial returns on that investment, and can operate cost-efficiently. The Layers Model forces these infrastructure companies to bear all of the costs of regulatory compliance, public services such as payment into the Universal Service Fund, and the cost of buildout, with less chance to recover these costs. Prudent management of these companies will dictate that they build in areas where the return is maximized – primarily the high-volume urban areas.

- The model doesn't work for policy. The greatest issue faced by the industry today is not a lack of understanding of how the Internet works, but rather the fact that major elements of the Internet are not within the control of easily-identified companies. Nor are the majority of Internet users, who create and use content and applications, subject to U.S. laws. In such an environment, policymakers often attempt to assign liability or obligations to service providers because they are easy to identify, not because the policymakers don't understand how one layer differs from another. Use of the Layers Model will not change the reality of this easy, but misplaced, assignment of obligations.

Toward Emergent Policy Models

If existing models – including the Layers Model – are insufficient as a foundation for effective public policy for the Internet, what constitutes a more effective approach?

There is little consensus as to what the approach should be, though there is general agreement that the public interest will best be served by an environment that fosters minimal regulation, investment in infrastructure, competition among services, innovation, and profitability.

There are many reasons why no single model has emerged in the first decade of the commercial Internet, and several reasons why a single model may not be seen soon, if ever:

- Reorganization of the FCC. Chairman Michael Powell has established a vision for a reorganized Federal Communications Commission that would focus less on micro-management of service providers and more on enforcement issues. While there has not been much announced since the bureau structure of the FCC was re-shaped in 2002, whatever shape and focus the FCC ultimately adopts will play strongly into the shape of the policy model that emerges. Also in play are the threat/promise of Congressional intervention in shaping the FCC and the ever-present possibility that someone new – with a differing vision – will assume chairmanship of the FCC before the current reorganization is completed.

- USIIA Policy on Deployment of Broadband. Companies within the broadband industry have, over the past several years, adopted policies and agreements that will eventually replace the need for government oversight – particularly in the area of network access.

  In October of 2001, the board of directors of the U.S. Internet Industry Association formally adopted a policy position on the deployment of broadband:

  1. Commit to the goal, before this decade is out, of Broadband Internet service available to every home, business, and school in America.

  2. Specify that Broadband Internet services are inherently interstate and international in nature, and should not be subject to regulation by the States.

  3. Commit to network deployment, interoperability, security, quality of service and reliability as fundamental to achieving effective services.

  4. Ensure the continuation of innovation and development for advanced Internet services by establishing a permanent tax credit for corporate research and development.

  5. Commit to economic policies that encourage investment in new and emerging Broadband technologies, including wired, fiber optic, cable, wireless, and satellite technologies.

  6. Ensure that consumers have access to the Broadband Internet Access Provider(s) of their choice by requiring that operators of Broadband networks, regardless of the technology they employ, provide for access to and non-discriminatory prices and services for Internet Access Providers.

  7. Establish a regulatory environment that stimulates investment in high capacity network services and responds quickly to changes in technology and the Broadband industry through deregulation, regulatory parity, and the doctrine of laissez-faire.

  8. Ensure that advanced technologies and services are affordable and accessible for communities and individuals in under-served areas through the implementation of subsidies, investment incentives, and aggregation of demand.

  9. Ensure that access to Broadband Internet services is affordable by establishing a permanent moratorium on federal, state, and local taxation of all forms of Internet access.

  10. Continue support for Federal programs such as the Commerce Department's Technology Opportunities Program (TOP), the CTC (Community Technology Centers) program and the E-rate for schools and

libraries in order to provide greater access to Broadband at the local level. This includes support for initiatives to develop and implement Broadband applications for those with disabilities.[5]

➢ Memoranda of Understanding. The USIIA policy was followed in mid-2002 with Memoranda of Understanding signed with Verizon and SBC regarding operations in a deregulated broadband environment including statements regarding regulatory parity among technology platforms and availability of commercial contracts at rates negotiated on the basis of market forces.[6] Notably, these companies along with BellSouth and Qwest have, with the support of the FCC, entered into negotiations with competitors to effect such commercial contracts in 2004.

➢ HTBC Connectivity Principles. In a similar vein, the High Tech Broadband Coalition, a coalition of six trade associations that support the effective deployment of broadband, issued a statement of Broadband Connectivity Issues in 2003. These issues address consumer rights and the ability of non-affiliated ISPs to connect to broadband networks. The specific principles outlined in the document are:

"Broadband Principles for Consumer Connectivity

The FCC should adopt its tentative conclusion that wireline broadband Internet access services are Title I services that should be subject only to minimal regulation. The same classification should also apply to stand-alone broadband transport service offerings.

Broadband Connectivity Principles

The FCC should endorse the following broadband connectivity principles to assure that consumer interests are protected. It is premature to determine if these principles are actually being undermined, thus it is not now necessary for the FCC to promulgate rules in this area. However, the FCC should vigilantly monitor cable modem and DSL broadband services as they develop, expeditiously review any complaint and reassess the marketplace in 2 years to assure:

1) Consumers receive meaningful information regarding their broadband service plans.
2) Broadband consumers have access to their choice of legal Internet content within the bandwidth limits and quality of service of their service plan.
3) Broadband consumers are able to run applications of their choice, within the bandwidth limits and quality of service of their service plans, as long as they do not harm the provider's network.
4) Consumers are permitted to attach any devices they choose to their broadband connection at the consumer's premises, so long as they operate within the bandwidth limits and quality of service of their service plans and do not harm the provider's network or enable theft of services.

ISP Access

The FCC should adopt its tentative conclusion that wireline broadband Internet access, including broadband transport service, are Title I services that should be subject only to minimal regulation. In order to promote broader consumer access, innovation and choice, wireline broadband providers, including ILECs and their affiliates, should be permitted to negotiate privately the terms of broadband transport service agreements with affiliated and unaffiliated ISPs and other customers, subject to the following "safe harbor" requirements for a transition period:

1) Wireline broadband providers shall honor existing transport agreements (whether tariffed or contracted) with unaffiliated ISPs. Where ISPs have purchased transport services under tariffs, the broadband providers will be obligated to maintain those services under the same terms and conditions as specified in the tariff, but

[5] "USIIA Policy With Respect To Deployment of Broadband Internet Services," http://www.usiia.org/legis/broad.doc
[6] See http://www.usiia.org/news/VerizonMOU.pdf and http://www.usiia.org/news/SBCMOU.pdf

provided for under a new contractual agreement. ISPs and carriers may negotiate alternative service agreements if they choose.

2) Wireline broadband providers will make available a basic transport service to unaffiliated ISPs in the following manner:

   a. Wireline broadband providers will make available to unaffiliated ISPs a basic broadband transport service with the same basic functionality and at the same cost (volume, terms and conditions) that it provides to its affiliated ISPs.
   b. Such agreements shall cover the basic broadband transport functionalities between qualified end user locations and the wireline broadband provider's designated interconnection point.
   c. A basic broadband transport agreement shall be posted on the wireline broadband provider's website. During this transition, unaffiliated ISPs may agree to the terms specified in the posted agreement or may negotiate other commercial arrangements beyond the basic service terms of the posted agreement.

3) These transition and "safe harbor" requirements will expire no later than two years from the effective date of the FCC's order in this proceeding. To the extent that the FCC imposes any requirements on broadband providers thereafter, such requirements shall apply to broadband platforms in a competitively neutral fashion." [7]

➢ Changes in the structure of the Internet. Efforts to craft a policy foundation on the physical or engineering model of how the Internet works are almost certain to be rendered useless if that physical model changes. In a handful of high-level programs, the Defense Advanced Research Projects Agency (DARPA) is considering how to do exactly that – shifting from the less-efficient Ethernet and IP-based networks to more efficient networks that may not even use packets or existing network topologies, relying instead on a distributed networking model.

Regardless of how the use of a device such as MCI's Layers Model might simplify understanding of the Internet for policy purposes, it is difficult to escape its inherent flaws – including the underlying competitive advantages it would provide to a select few companies. Nor is it possible in the short term to define a model of the Internet that adequately resolves major policy issues in the long term.

Some of these issues may in fact be resolved through the reorganization of the FCC, through industry advances in self-regulation, through the actions of an unfettered and competitive marketplace, or through changes in the physical structure of the Internet itself.

[7] See http://www.nam.org/s_nam/bin.asp?CID=200969&DID=227140&DOC=FILE.PDF

Layer Architectures and Regulation in Telecommunications

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Introduction

A layered policy model for regulation of telecommunications, as proposed by Kevin Werbach[1] and Rick Whitt of MCI[2], has many attractions. The telecommunications industry used to consist of a collection of separate and vertically integrated sectors providing different services. It is now evolving towards a collection of heterogeneous networks unified at the Internet Protocol (IP) layer. In this converged network, a growing variety of services will be provided on top of the basic connection. If regulation is to be applied in the future, it should work along the lines of natural technological and economic trends and not at cross purposes to them.

An extreme example of a layered policy model would force structural separation on the industry. Some of the layers, primarily the ones without adequate competition, might have to be provided by companies that would work at those layers only. That would conform to general trends in the economy. Largely because of better communication and the resulting lowered transaction costs, most industries have been restructuring into entities that operate on larger scale, but smaller scope. The computer industry is an example par excellence of this evolution, moving from the vertically integrated mainframe manufacturers of a few decades ago to specialists supplying operating systems (such as Microsoft), microprocessors (Intel), memories (Micron), hard disks (Seagate), as well as systems integrators (such as Dell).

Even the telecommunications industry has learned the benefits of horizontal layering. Such layering had been in use in internal operations for a long time, to get the usual benefits of such structures. But at the corporate level, the story was different. The U.S. federal government had to fight hard in the 1960s and 1970s to allow competition in customer premise equipment, and in the 1970s and 1980s to introduce competition in long distance services (culminating in the forced breakup of the Bell System in 1984). But as time passed, and the benefits of horizontal layering became greater and clearer, AT&T in 1995-96 voluntarily separated its service provider part from its supplier arm (which became Lucent).

There are extensive historical precedents for a layered policy model in transportation. Those precedents, together with the historical record of regulation in telecommunications, suggest, though, that it will not be easy to implement the Werbach-Whitt model in the U.S., and that even when it is implemented, it will not be a panacea. The main problem is that even though technology does not in general diffuse on "Internet time," these days it does move faster than the political and regulatory processes. This is aggravated by the difficulties in demarcating layers, and the somewhat unstable nature of layered structures that are often observed. Moreover, layered regulation might make it hard to obtain full benefits from price discrimination, one of the key elements of most regulatory schemes.

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[1] Kevin Werbach, A layered model for Internet policy, Journal of Telecommunications and High Technology Law, (2002). A Sept. 2000 draft is available at http://www.edventure.com/conversation/article.cfm?Counter=2414930.

[2] Richard Whitt, A Horizontal Leap Forward: Formulating a New Public Policy Framework Based on the Network Layers Model, An MCI policy paper, March 2004, available at http://global.mci.com/about/publicpolicy/presentations/horizontallayerswhitepaper.pdf.

Historical Precedents

Telecommunications services (including postal systems) have traditionally been operated as monopolies, often run by governments. Even when run by private enterprises, they have generally been heavily regulated, with separate regulatory regimes for different services. Thus there are few precedents for the Werbach-Whitt proposal in telecommunications.

On the other hand, transportation offers a rich source of examples that one can draw analogies from. In particular, in Britain and in the United States, river navigation projects, canals, and turnpikes in the 18th and 19th centuries generally (but not always) had structural separation imposed on them at inception. They could not provide complete transportation services, and could only offer their facilities to carriers who transported goods and passengers in their own boats and carriages.[3]

Charters for river navigation projects, canals, and turnpikes provided for differential tolls, depending on the goods being transported, thus responding to the incentives to price discriminate (these tolls were prescribed in detail, unlike the technologies to be used, which were left to operators to choose). This structural separation and the carefully constructed toll schedules were a compromise between the desire to avoid a monopoly and the need to provide funding for construction and operation.

Although structural separation generally did the job it was assigned, it was not perfect, as there were attempts to bypass the limits imposed by charters. For example, canals often controlled all the convenient storage warehouses. A more serious problem was that the tolls imposed by the charters were only maxima. Operators, although possessing a local monopoly, often found it more profitable to charge lower tolls, and that allowed them freedom to engage in unpopular pricing practices.

Early railroad charters in both Britain and the United States were patterned after canal charters, and also envisaged structural separation (as well as differential tolls). It was expected that independent carriers would bring their own wagons and run them on the rails of the new iron roads. However, this arrangement, while it did persist on some railroads for a while, in most cases broke down very quickly (and governments accepted this quickly). Railroads decided to control all carriage on their facilities. The reasons were a combination of safety issues and economic incentives.

Railroads were able to accomplish this in spite of their charter because they had ways of impeding operations of rivals (such as denying them access to unloading facilities, or water for their locomotives, as well as just plain refusal to deal).

The main lesson from the transportation experience is that for structural separation (or milder forms of layer regulation) to work, when that is not in the interests of the service providers, the interfaces between the layers have to be simple ones. That appears to have been pointed out first by Gerry Faulhaber in an analysis of the U.S. telecommunications market.[4] In particular, he found striking contrast in the degree of competition that emerged in long distance access in intrastate markets, which demonstrates how incumbents can impede competition when it is in their interests to do so.

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[3] A.M. Odlyzko, Pricing and architecture of the Internet: Historical perspectives from telecommunications and transportation, to be presented at TPRC 2004, available at http://www.dtc.umn.edu/~odlyzko/doc/pricing.architecture.pdf.

[4] G.R. Faulhaber, Policy-induced Competition: The Telecommunications Experiments, *Information Economics and Policy*, vol. 15 (2003), pp. 73-97. Available at http://rider.wharton.upenn.edu/~faulhabe/Policy-Induced%20Competition.pdf.

Problems with the Layers Model

The layered model has often worked in the past in transportation. But it has not worked without difficulties, and sometimes broke down. With rapidly changing technologies and rapidly evolving industry structure, there would be many temptations and opportunities for service providers to evade limitations through either technical or political means (as has happened in the past).[5] There would be the added complexity of trying to impose the new regulatory model on an existing and very complicated industry structure. In particular, wireless service providers and cable networks, which have been very lightly regulated so far, would have to be brought into the system.

Hence it is hard to imagine most of the players in the industry coming to a consensus. But if they do not reach a consensus, imposing a new regulatory model would take many years, given the interactions of the U.S. legislative, regulatory, and legal systems.

The technical challenges of imposing a layers model should not be underestimated. The definition of equal access becomes difficult when the underlying technology inherently involves statistical multiplexing of traffic from a variety of users (as happens on a cable channel at the physical layer, or on just about any Internet Protocol link at the packet level). Moreover, this issue can be made even more difficult than absolutely necessary by various actions of the service providers, and so regulatory models might heavily influence technological choices, sometimes in undesirable ways.

There is also a very fundamental problem with the layer model related to the inhibiting effect it would have on price discrimination. Differential pricing, in which customers pay varying prices for what may be essentially the same goods or services, are at the heart of regulation.

In telecommunications, we observe (see Table 1 in A.M. Odlyzko, Pricing and architecture of the Internet], for example) that users pay rates per megabyte of data varying between $0.0001 (for movies delivered over cable) to $3000 (for text messages over wireless). This creates strong economic incentives for price discrimination and against charging per byte or per packet. A physical layer service provider that charged just by the volume of traffic could not take advantage of the variation in willingness to pay. But it is the basic connectivity provider that has the high costs that are of greatest concern in discussions about deployment of broadband, at least for residential users.[6] In transportation systems in the 18th and 19th centuries, the compromise between public policy of structural separation and the incentive to price discriminate in order to obtain enough funding for buildout of networks was to allow the turnpikes, canals, and railroads to charge according to the nature of the cargo.

For example, on the Beverley Beck navigation, sand paid 2 pence per ton, while iron and lead paid 12 pence.[7] These differential tolls were set through a complicated political process, and were based on the relative stability of valuations, and on inability to camouflage one type of good as another. In today's telecommunications, neither assumption applies, as where the value resides is subject to rapid migration, and many types of traffic can be concealed as others. Thus, if price discrimination is really important for the future of telecommunications, the physical layer carrier may have to be integrated vertically with higher level service providers.

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[5] See Fauhaber; and A.M. Odlyzko, Pricing and architecture of the Internet: Historical perspectives from telecommunications and transportation, to be presented at TPRC 2004, available at http://www.dtc.umn.edu/~odlyzko/doc/pricing.architecture.pdf.

[6] A.M. Odlyzko, The many paradoxes of broadband, First Monday, Sept. 2003, http://firstmonday.org/issues/issue8_9/odlyzko/index.html.

[7] A.M. Odlyzko, Pricing and architecture of the Internet: Historical perspectives from telecommunications and transportation, to be presented at TPRC 2004, http://www.dtc.umn.edu/~odlyzko/doc/pricing.architecture.pdf.

Conclusions

The layered policy model for regulation of telecommunications is attractive, and some form of it may very well arise. However, we should not expect it to arise quickly or painlessly, and even if it does arrive, it will not solve all problems. The two main problems are that the political process needed to introduce this model is not fast, and that such a model might inhibit differential charging.

There is a possibility that only a very weak form of the layer model might be needed. It appears that technology and financial market dynamics might lead to several competing access methods being available to most customers, in particular DSL, cable, and wireless.[8] If that happens, we might end up with a multi-modal telecommunications system, somewhat similar to the current transportation system, in which regulation can be very light.

[8] A. M. Odlyzko, The many paradoxes of broadband, First Monday, Sept. 2003, http://firstmonday.org/issues/issue8_9/odlyzko/index.html.

Do We Really Want A New Regulatory Model?

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Introduction

Where competition appears to be working the best is precisely where public policies have interfered the least. An undisputable fact is that the demand for unregulated services, including wireless, broadband, instant messaging and other IT services, have grown rapidly in recent years, while regulated local telephone lines have declined. This fact is the result of intermodal competition – competition between once distinct industries – that is making regulation unnecessary. Unregulated wireless phones seem everywhere and now account for more customer connections than regulated telephone lines do.[1] Besides local and long distance calling, these wireless services permit the same features that wireline services do, such as caller ID, at competitive prices.

Unregulated high-speed Internet services, while capable of transporting data and video information, are beginning to offer voice-over-Internet telephone services that completely replace traditional telephone calling. Other forms of competition, such as instant messaging and other computer-based services like IP teleconferencing, are making plain old telephone service seem passé. In short, regulation of telecommunications industries is no longer needed. Competition and innovation appear more vibrant where regulations have interfered the least.

Deregulation and Convergence

The need to deregulate is highlighted by the fact that industries are subject to different rules and regulations, not depending on what services they vend, but what industry they are classified as being. The fact is that previously disparate industries have now converged into an Information Sector. Today, voice, video and computer bits are transmitted over optical fiber, coaxial cable, copper cable, the airwaves, or by some combination of these technologies. Because of scientific advances, these once distinct industries can now transport any number of media – TV programs, telephone conversations, music, pictures and text. When the phone rings, a customer receiving a call may not know the industry or industries that were responsible for transporting the call or whether the call traversed some combination of facilities from telephone, cable TV, or wireless companies. In other words, from the customer's perspective, when the telephone rings, they do not care how the caller's voice is transported, as long as the call goes through. Simply put, consumers buy services, not industries.

Yet, regulators watch over these industries with different agencies, using different rules and different measurements of competition. The FCC has a Wireless Bureau, Wireline Bureau, International Bureau, and Media Bureau, each with unique rules, sometimes to regulate the same type of service. For example, rules governing high-speed services differ depending on whether these services are provided over cable TV networks or telephone networks. As a result, outdated regulatory rules are altering the competitive playing field, and affecting market outcomes. Rules that compartmentalize competitors into discrete industries underestimate intermodal competition and falsely conclude that each industry is concentrated. That conclusion unwisely justifies regulations. Simply doing away with these regulations would be a positive thing for heightening competition and benefiting consumers.

[1] There are 12% more wireless subscribers (163.7 million) according to the Cellular Telecommunications & Internet Association (see www.CTIA.org, downloaded on May 13, 2004), compared to total incumbent local exchange switched access lines (146.8 million) reported by the FCC (see www.FCC.gov, ARMIS Report 43-08, 2003, downloaded on May 13, 2004).

MCI Proposal and Industry Convergence

A recent proposal cites the harm of compartmentalizing competitors, but suggests not deregulation, but reforms in regulation. Specifically, MCI proposes regulatory reforms based on an engineering framework of communications system layers.[2] The proposal suggests that the telecommunications physical layer (essentially the transport infrastructure) remain regulated, while other layers, such as applications and content be unregulated. Ironically, MCI is proposing to have one of its primary competitors locked up in regulation and unable to compete by service differentiation. Under the MCI proposal, the owner of telecommunications infrastructure will have no control over the services offered on its network, since applications and content layers work independently of the physical layer. MCI and others are free to ride on someone else's network, a network that remains regulated. In this way, transport services look like a commodity. What the proposal offers to fix, the compartmentalizing of industries, it breaks by compartmentalizing competitors into layers. The proposal places no value on economies of scope and vertical integration, ignoring network efficiencies that provide consumers low costs.

Effectively, the MCI proposal works to separate regulated and unregulated competitors, which would perpetuate regulations and protect companies that have not invested in telecommunications infrastructure. For competition to work effectively, public policies need to erase the industry and layer definitions and let firms compete unimpeded, unregulated.

The layers concept preserves regulation for those who own transport, while bifurcating applications, content and service functions. In effect, it takes the most costly function of the communications business – building and operating the transport network – and leaves it under onerous regulations, but it frees more profitable services from regulation. Because it is so costly, few firms want to build telecommunications and fiber-to-the-home networks without being able to charge customers for the services that ride on it. It is these very services – applications, content, and communications services – that make investment in infrastructure viable. These applications and services may have a marginal cost near zero, but these are what end-users buy.

Just as consumers do not buy industries, they do not buy transport. What consumers *do buy* are services, the very thing that the layers concept attempts to wrestle away from the builders of transport facilities. It would be better for competitors to settle these disputes in the market. The bottom line is that a layers model promotes that wrong behavior – it would promote free loading on someone else's network, impede facility-based competition and under fund the basic network that consumers depend upon for universal service. A better concept would be to let economics work by encouraging intermodal competition and facility-based competition, as well as encouraging competing suppliers for these networks. In this way, competition would self-regulate the market where regulation has failed.

Conclusion

First it was proposals to lower access charges to help long distance companies, later it was driving wholesale prices below cost to help competitive local exchange carriers (CLECs), and now it is regulating by layer to eliminate network owners as competitors of telecommunications services. Before we consider an engineering solution for regulation, maybe we should try an economic model that works – competition. Public policies need to encourage building the physical layer, not encouraging freeloaders to ride on it. Therefore, any suggestion that we need a new regulatory model should be viewed with skepticism and as a step away from telecommunications deregulation.

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[2] Richard S. Whitt, "Taking a Horizontal Leap Forward: An MCI Proposal to Reform Federal Communications Law Based on the *Layers* Framework," New America Foundation, March 18, 2004.

Pipe Dreams: Why "Dumb Pipe" Models Make for Poor Public Policy[1]

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Cato Institute

The debate over mandatory "open access" versus private (contractual) carriage for telecom or broadband networks is often cast in terms of "dumb pipes" versus "intelligent networks." A purely dumb pipe, for example, would be a broadband network without any propriety code, applications, or software included. An intelligent network, by contrast, would integrate some or all of those things into the system. While this dichotomy greatly oversimplifies matters, it raises an important question: As a matter of public policy, should lawmakers be mandating one type of business arrangement or system architecture over another? More specifically, debates over open versus closed pipes raise the question of whether vertical integration within the communications and broadband marketplace is to be feared or welcomed.

That question is receiving increasing attention in Internet policy circles today as numerous scholars begin to conceptualize this market in terms of layers. Most of these "network layer" models divide our increasingly packet-based Internet world into at least four distinct layers: (1) Content Layer; (2) Applications Layer; (3) Logical/Code Layer; and, (4) Physical/Infrastructure Layer. Officials with MCI have been aggressively pushing this model and suggest that it should be under consideration as a framework for future revisions of the Telecommunications Act of 1996.[2]

The layers model is an important analytical tool that could help lawmakers rethink and eventually eliminate the increasingly outmoded policy paradigms of the past, which pigeonhole technologies and providers into discrete industrial regulatory categories (or "vertical silos" such as Title II, Title III, Title IV, etc). But should the layers model be taken a step further and be formally enshrined as a new regulatory regime? And should a "layer-breaker" be considered a law breaker? Some scholars and policymakers appear to be moving in that direction with their advocacy of dumb pipe mandates that insist that providers essentially stay put in their primary layer of operation.

Far from being antithetical to innovation and competition, however, vertical integration can play a vital role in ensuring the development of a more robust broadband marketplace. Many broadband service providers (BSPs) and other Internet service and applications providers will seek to expand and diversify their range of consumer offerings by integrating into other layers. Policymakers should not proscribe such layer-jumping and they should be agnostic with regard to the intelligence of broadband networks in general. While the dumb pipe approach may have great merit as a business model and eventually become the approach many BSPs adopt over time, it should not be enshrined into law as a replacement regulatory regime. Added network "intelligence" in the form of bundled applications and services can provide the public with an expanded array of choices that make their Internet experience more user-friendly. More importantly, dumb pipe mandates might have a discouraging effect on competition in the creation of entirely new networks and services if these mandates come to be a formal prohibition on vertical integration between layers. For these reasons, a dumb pipe mandate would be quite dumb indeed.

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[1] This essay is condensed from the forthcoming study entitled, "Are 'Dumb Pipe' Mandates Smart Public Policy? Vertical Integration, 'Net Neutrality,' and the Network Layers Model."

[2] See: Richard S. Whitt, "A Horizontal Leap Forward: Formulating a New Public Policy Framework Based on the Network Layers Model," *MCI Public Policy Paper*, Version 1.0, Dec. 2003, http://global.mci.com/about/publicpolicy/presentations/horizontallayerswhitepaper.pdf.

Analytical Concept or Regulatory Mandate?

While the network layers model can help public policymakers rethink and eventually eliminate increasingly outmoded regulatory paradigms, it should remain an analytical framework and not be enshrined into law as the new regulatory paradigm for the communications marketplace. But one of MCI's recent white papers suggests that the network layers model should be used to potentially forbid vertical integration between layers.[3] MCI argues that cable and telco broadband service providers (BSPs) with "market power" in the physical layer must: (1) make their networks available to rivals on a wholesale basis, or (2) be prohibited from vertically integrating into other layers. In other words, much of the old Title II common carriage regulatory regime would get transferred over to the new physical layer of the network layers regulatory model.

This clearly raises the prospect of the layering model becoming a series of formal regulatory firewalls or quarantines on some firms to encourage or even mandate a "dumb pipe" approach to the provision of communications and broadband services in the future, meaning that BSPs should generally not provide any integrated content or applications over the lines they own for fear of discrimination against independent suppliers. Until recently, however, the "dumb pipe" or "stupid network" thesis did not really have any clear public policy implications. It functioned more as an ideal to which the industry should aspire. George Gilder[4] and David Isenberg,[5] for example, made the case for why dump pipes and stupid networks made sense from an engineering or business perspective. But the question left unanswered was whether the dumb pipe approach was merely a conceptual tool and a business model, or whether it should become the central animating principle for future regulation of the entire broadband / Internet marketplace.

Dumb Pipes 'Lite': The Net Neutrality Proposal

Proposals to impose "Net neutrality," or "digital discrimination" mandates on this sector, show that the latter may soon be the case. Several major software and e-commerce firms have formed the Coalition of Broadband Users and Innovators (CBUI) and petitioned the FCC to adopt rules ensuring that cable and telephone industry BSPs will not use their control of high-speed networks to disrupt consumer access to Web sites or other services.[6]

In essence, the CBUI and academics who support Net neutrality regulation are asking the FCC to mandate a "dumb pipe-lite" approach to the provision of broadband services. In other words, as a matter of public policy, BSPs should be discouraged from bundling new services and software into their broadband pipes. Much like the antitrust battle over which applications Microsoft should be allowed to bundle into its Windows operating system, regulatory proponents in this case are asking for restrictions on the vertical integration of content, applications, and conduit by BSPs. In the Microsoft skirmish, regulatory proponents sought the equivalent of a "dumb browser." In the Net neutrality battle, they seek a dumb pipe. But there are good reasons to question the assumption that dumb pipe mandates constitute smart public policy.

Disincentives to Innovate and Create Entirely New Platforms

Do we just want one big dumb pipe, or many competing dumb *and* smart pipes? Net neutrality or dumb pipe mandates will force policymakers to put that question front and center. It would be highly unfortunate, and somewhat ironic, if the end result of a net neutrality mandate was to discourage the development of alternative, competing

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[3] Richard S. Whitt, "Codifying the Network Layers Model: MCI's Proposal for New Federal Legislation Reforming U.S. Communications Law," *MCI Public Policy Paper*, Version 1.0, March 2004, http://global.mci.com/about/publicpolicy/presentations/layersmodelfederallegislation.pdf.

[4] George Gilder, *Telecosm: How Infinite Bandwidth Will Revolutionize Our World*, (New York: The Free Press, 2000), p. 269.

[5] David Isenberg, "Rise of the Stupid Network," Computer Telephony, August 1997, pp. 16-26, http://www.rageboy.com/stupidnet.html.

[6] Coalition of Broadband Users and Innovators, *Filing to the Federal Communications Commission in the Matter of Appropriate Framework for Broadband Access to the Internet over Cable Facilities*, CS Docket No, 02-52, January 8, 2003. p. 2, http://204.153.212.66/events/cbui/docs/cbui1-8.pdf.

network infrastructures. But that is exactly what it might accomplish. If a Net neutrality / dump pipe mandate is put in place, carriers might struggle to find ways to recoup their significant fixed costs of doing business and be discouraged from further innovating.

It may very well be the case that it makes good business sense for BSPs to just stick to providing a fast, dumb pipe to consumers.[7] But as a matter of public policy, dumb pipes should not be mandated as the law of the land since there are good reasons to allow competition in network architectures between dumb and smart systems to see which consumers truly prefer. Perhaps the most important reason to reject dumb pipe mandates lies in the investment disincentives for both existing and potential infrastructure operators. A dumb pipe regulatory mandate would essentially be like telling infrastructure operators and potential future operators of high-speed networks that: *your networks are yours in name only and the larger community of Internet users—through the FCC or other regulatory bodies—will be free to set the parameters of how your infrastructure will be used in the future*. Hearing that message, it is fair to ask why a network operator or potential operator would ever want to invest another penny of risk capital in a sector that was essentially governed as a monolithic commons or public good.

While Net neutrality and dumb pipe regulatory advocates obviously feel quite passionately about the question of innovation at the edge of the network, where is the concern for innovation at the core of the network, or the innovation and investment needed to bring about entirely new network infrastructures? They are apparently content with the networks of the present and feel comfortable imposing regulations on existing BSPs to ensure that innovation is maximized at the edge of those existing systems. Is such pessimism about future technological development or entirely new networks warranted? History and common sense suggest the opposite is the case. Ours is an innovative culture and new technologies and industry sectors have developed in the past, and will be developed in the future, but only if creators: (1) believe they can reap the fruits of their labor, and (2) are not directly or indirectly prohibited by government from entering new markets or providing new services.

Instead of being so preoccupied with merely maximizing consumer welfare within the confines of existing systems, Net neutrality and dumb pipe proponents—especially the impressive list of well-heeled companies that are part of CBUI—need to put more thought and energy into the question of how the networks of the future are going to get funded and built. The principle that CBUI members and dump pipe proponents seem to ignore is that *competition in the creation of networks is as important as competition in the goods and services that get sold over existing networks*. Net neutrality mandates are at cross-purposes with that goal.

Openness and (Semi-) Dumb Pipes Will Likely Prevail Naturally

What is the optimal configuration for the high-speed networks of the future? Network neutrality proponents seem to think they know the answer to that question and want the government to take steps to preserve their preferred model well into the future. But instead of boxing this sector into today's favored approaches, isn't there something to be said for competition in network architectures? Stated differently, is today's Internet the only one we will ever know? Is it unthinkable to envision a world with multiple Internets, or "Splinternets"?[8] Although "layers" offer a fitting way of thinking about today's world, just as vertical silos made sense in the past, it could be the case that horizontal layers will not accurately describe the Internet, or Internets, of the future.

Proposals to formally codify the layers model, adopt Net neutrality regulations, or impose dumb pipe mandates would largely ignore this logic and instead force a rigid new regulatory regime upon this sector in the name of preserving "openness" on today's existing systems. Open systems do have many advantages over closed systems, and if that is the way things naturally evolve, so be it. Other times, however, closed systems make all the sense in the world. But policymakers shouldn't dictate this outcome of this standards battle one way or another. They should remain

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[7] Anton Wahlman and Brian Coyne, "The Dumb Pipe is the Only Money Pipe," Needham & Company, Inc., *Equity Research Note*, December 15, 2003, http://www.vonage.com/media/pdf/res_12_15_03.pdf.

[8] Clyde Wayne Crews, "Pick Your Net," *Forbes*, April 2, 2001, http://www.forbes.com/forbes/2001/0402/036.html.

fundamentally agnostic with regard to network architecture. In the end, the Internet—or whatever future interactive platforms develop—will probably be a mix of open and closed systems, and that's probably how it should be.

Moreover, BSPs would be committing economic suicide if they attempted to foreclose all the network connections or opportunities that their users desired. It is in the best interests of network operators to ensure that a great degree of "openness" remains intact if they hope to retain their customers and expand their networks. As Anton Wahlman and Brian Coyne argue: "Consumers will gravitate to pipe providers that do not restrict their activities…. Any pipe provider who tries to restrict uses of the pipe to favored services (voice, video or data) in a 'walled garden' will likely be at a severe or impossible disadvantage, with consumers leaving for other pipes."[9]

If BSPs were to interfere with the routine activities in which web surfers engaged, it would likely discourage network utilization and expansion, thus sacrificing future profits. Such meddling would be bad for business and generate negative publicity. Moreover, such meddling would send a powerful signal to rival BSPs that an opportunity exists to enter that market and offer to consumers a more open web surfing experience. It is in the best interests of broadband providers to carry as much traffic as possible and even allow other firms to lease capacity from them and resell service on their own. From the incumbent's perspective, it will often make more sense to encourage a competitor to serve the public over the incumbent's existing wires rather than encouraging them to build new platforms and offering consumers a way to bypass the incumbent's network altogether. Incumbents will want to set the wholesale rate just high enough to recoup their fixed costs without charging so much as to drive rivals off their network entirely. This point is often overlooked in debates over mandatory open access regulation.

The Importance of Pricing Flexibility

Often overlooked in discussions about Net neutrality mandates is the role of pricing. One of the most interesting debates that has taken place behind the scenes in recent years involves the question of how broadband access should be priced in the future. Would a per-minute or per-bit pricing scheme help conserve pipe space, avoid congestion, recover costs and enable BSPs to plow the savings into new capacity? It's possible, but nothing much has come of this debate, and no carrier has acted on such a plan.

In the future, however, they might want to experiment with alternative pricing schemes and they should have the freedom to do so without fear of regulatory repercussions. Dumb pipe mandates or Net neutrality regulations might prohibit such innovative pricing schemes from being employed in the first place. Supply and demand could be better calibrated under such pricing schemes and broadband operators may be better able to recoup sunk costs and make new investments in future infrastructure capacity or network services. Regardless, it should be left to markets, not regulators, to determine what pricing schemes are utilized in the future to allocate scarce space on broadband pipes.

Conclusion: What About Regulatory Capture and Property Rights?

In conclusion, it is worth mentioning that property rights should play a role in deciding the outcome of these issues. Broadband providers are shareholder-owned entities that have genuine property rights in the networks they develop and own. The risks inherent in the massive ongoing investments being made by these companies fall squarely on the shoulders of these firms and their investors. While some of the underlying infrastructure of the regulated era of the past remains in place, it is increasingly becoming obsolete and is gradually being replaced. Billions of dollars of new investment is made every year by many of today's network providers without the assumption that the government and captive ratepayers will be there to bail them out in the future. A forced access mentality, however, argues for a return to the methods of the past as costs are spread more widely throughout the industry, and networks are shared as a natural monopoly or an essential facility. This represents a step backward and entails constant regulatory oversight and intervention in the Internet sector.

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[9] Anton Wahlman and Brian Coyne, "The Dumb Pipe is the Only Money Pipe," Needham & Company, Inc., *Equity Research Note*, December 15, 2003, p. 5, http://www.vonage.com/media/pdf/res_12_15_03.pdf.

Finally, there's the potential for regulatory capture. Given the long and lamentable history of telecommunications regulation being captured by various interests for their own ends, it is evident that various special interest groups will attempt to "game" the regulatory process in their favor if Net neutrality regulations or dumb pipe mandates are imposed. Moreover, the network layers model and corresponding regulatory requirements suggests that greater FCC regulation of the Internet and the broadband marketplace is in store, and for that reason alone the plan to codify into law the network layers model and dumb pipe theory should be rejected.

Peeling the "Layered Regulation" Onion

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The Appeal of the Layered Approach

Many complex, high-tech products and services can be usefully viewed as a series of "layers." Like an onion, all the layers work together to produce the end result, each layer in physical or logical contact with its two neighbors. Engineers have proposed layered models for the architecture of telecommunications networks, the Internet, and computer systems. Recently, policy analysts and legal scholars have embraced this same engineering architecture as a template for reform of telecommunications regulation.

The so-called "layered regulation" of telecommunications—a framework that emerged out of debates over Internet policy—starts with functional distinctions of the various layers, from the physical infrastructure layer at the bottom of the hierarchy to application software and content near the top. The independence of each layer from the others is recognized as a powerful means to promote innovation. The central principle of layered regulation holds that regulators can reduce barriers to innovation by entrants and incumbents alike by ensuring their activities remain unencumbered by what occurs in other layers. If, instead, regulation was to "cross" two or more layers, innovation at one layer could be hindered by dependence on decisions made at another layer. Such dependence would occur, for instance, if voice service that rides on the Internet Protocol layer as a packet-switched application (i.e., voice-over-IP) was regulated in the same way as voice provided over the transport layer of the public switched network (PSTN).

An important corollary of layered regulation claims that, since upper layers depend on lower layers, the lowest layer—typically the physical network infrastructure—is the locus of the greatest monopoly power, and therefore, is where regulation should be concentrated. In practice, this translates into a policy that quarantines the "last mile" of the network from participation in complementary service markets.

The layered approach to regulation has several attractive features, beginning with its observation that current institutions are inconsistent with today's telecommunications technology. Presently, different regulations are applied to different networks—the switched wireline network, the cable TV video network, the mobile wireless network and so on. Each of these distinct service "silos" is further sub-divided by state-federal jurisdictions and by residential-business distinctions. Such Balkanization is irrelevant in a world of digital convergence in which voice, video, and data are digitized and transported over media of all kinds: copper pair, coaxial cable, optical fiber, the radio spectrum, even the electric power grid. Carving up the market into distinct services impedes the competition made possible by digital technology. Regulation applied to each service will inevitably follow a distinct evolutionary path, resulting in asymmetric treatment of potential competitors, further distorting the working of the competitive mechanism.

The layered approach is also correct to emphasize incentives for investment and innovation as the key criterion in the design of regulatory institutions. Technological advances are occurring at a torrid pace, even relative to the impressive historical record of the communications sector. The technological interdependencies that arise with these services pose the danger that sluggish advance by one component can retard progress for the entire system. Layered regulation seeks to achieve rapid technical progress in delivery of the final service by removing an important obstacle to innovation in each distinct layer.

A Better Way to Slice the Onion

Despite several compelling features, layered regulation fails to adhere to some basic principles of economic regulation that may, among other implications, defeat its pro-innovation goals. A minimum test for government intervention requires that the improvement registered over the unregulated outcome—derived from constraining the abuse of monopoly power, internalizing spillover effects, or pursuing social goals—is not overwhelmed by the costs of implementing the regulation. Additionally, the proposed policy should be better than then next best, feasible alternative. It is not enough merely to identify desirable properties that flow from layered regulation; it must prevail and pass the test of full comparative analysis.

One place to introduce economic principles into the design of layered regulation is to use supply and demand to delineate service components—whether they are arranged in vertical stacks, horizontal layers, or a more elaborate mosaic. Only by accident will engineering layers coincide exactly with the economic definition of service markets. Even in engineering terms, distinctions between piece-parts of a network can be far from clear. In addition, engineering and economic distinctions may lead to conflicting conclusions. As an example, whether some short-text messaging feature is embedded in the chip set of a mobile phone or located in the server software at the mobile switching center matters a great deal to engineers, but is irrelevant to the mobile user, the arbiter of economic service markets.

Furthermore, assigning products to layers is not always obvious. Take the case of "broadband over power line" (BPL), a technology that transmits data over the electric lines. Assuming that BPL becomes commercially viable, equating the electric power grid with cable and telephone networks, and thereby justifying symmetric regulatory treatment, could cause collateral harm to the efficient operation, maintenance and modernization of the power distribution network. The source of this harm is the dual purpose of this physical layer and the inability of regulatory policy to isolate clearly the telecommunications function.

Nor are lower layers in the "stack" necessarily prone to monopoly as suggested by proponents of layered regulation. More often, when barred from engaging in service differentiation, physical infrastructure slips into commodity status and intense competition soon follows. This occurred in the personal computer industry for the BIOS (basic input-output system) that resides near the bottom of the PC stack, located between the operating system and microprocessor layers. In sharp contrast to the layers directly above and below that are dominated by Microsoft and Intel, respectively, the market for BIOS firmware is highly competitive.

By isolating the physical infrastructure layer and imposing restrictive regulatory rules on its owner, opportunities for an important source of network innovation may be lost. Quarantined to the physical layer, and constrained in its profitability, the infrastructure provider foresees insufficient return to justify the enormous investment that often is necessary to retrofit an embedded network for a new technology. As a result, innovation that could otherwise percolate through the layers and deliver significant advances in end-user services is never realized.

The Other Side of Crossing Layers

Layers that can be delineated from an engineering perspective could nevertheless exhibit strong scope economies. It is likely that such economies will only be realized through vertical integration that minimizes the costs of completing transactions at arm's length. Integration can also eliminate the "double markups" that occur when two or more firms exercise their market power at individual layers. More important than these static economies, however, vertical integration can erect strong incentives for investment when firms can also realize returns in the service markets of adjacent layers. This can be particularly beneficial in the case of innovative activity where the surplus generated by cost reductions and service improvements can otherwise be difficult to appropriate from a single layer.

The possibility that a firm operating in several layers of a network will foreclose un-integrated rivals—especially innovative start-ups—is a serious concern, but one that is easily overestimated. Such firms can, and do, employ

pricing, bundling, quality discrimination and interface control to frustrate their rivals. However, it is also well documented that firms possessing market power have strong incentives to facilitate competition in complementary products. Taking another example from the computer industry, Microsoft aggressively encourages entry into software and hardware markets that complement its famous operating system, despite its monopoly position and despite its predilection to exercise that market power. The profit motive also discourages a dominant firm from entering another layer when a more efficient, more innovative firm could supply that complement, provided the dominant firm is able to capture some portion of the rents generated by that complementer.

It is more than a little ironic that proponents of layered regulation see digital convergence as a reason to "de-laminate" the phone network,[1] and then to proceed to call for a quarantine of the physical infrastructure layer. Such a policy will inevitably impair the competition among platforms that is enabled by digital convergence. In contrast, when infrastructure owners are able to adopt cross-layer strategies to gain a competitive advantage over another platform offering, the consumer will be well served.

Summing Up

The layered framework is a useful schematic to organize complex networks like the Internet and telecommunications, but it is easy to be seduced by this orderly view. Superimposing this framework on regulatory institutions inevitably parts ways with the fundamental economics of these markets. While it holds great promise in promoting independent innovation, when we peel back the layers of the argument, the layered approach forgoes significant benefits that would only be realized by "violating" the layers.

Another drawback of imposing this engineering architecture on regulatory policy is that technology can change, and can do so quite quickly, while regulatory institutions are notoriously slow to react and to adjust. Incorporating the horizontal approach into institutions builds in rigidity that prevents regulation from adapting to the very innovative technologies that it seeks to promote. Who could confidently claim that technological advances will not occur in the future that would once again justify vertical silos?

Policy makers committed to facilitating innovation in modern digital networks have better alternatives at their disposal. These alternatives hold the promise of striking a balance between erecting profit incentives for inventing and deploying advanced technology while at the same time curbing monopoly power. For instance, the creation and dissemination of nonproprietary technical standards, especially open interface standards, along with obligations to interconnect and to maintain technical and commercial interoperability, would go a long way to promoting innovation while limiting the opportunity for abuse of monopoly power. Fortunately, institutions to support such arrangements would not have to be invented from scratch: the computer industry has ample experience implementing these concepts, and to a lesser extent, so too does the telecommunications industry.

[1] I borrow this term from Michael Katz, "Thoughts on the Implications of Technological Change for Telecommunications Policy," in Transition to an IP Environment, A Report of the 15th Annual Aspen Institute Conference on Telecommunications Policy, Aspen Institute: Washington, DC, 2001.