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Breaking the Ice:
Rethinking Telecommunications Law for the Digital Age

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Telecommunications is a trillion-dollar industry undergoing a massive transformation. As technology and market developments undermine long-standing business models and value chains, existing legal frameworks are failing. A "layered" model for communications policy would provide a better foundation for competition, investment, and innovation than the legacy "silo" model.

Just as water exists in three forms – solid ice, liquid water, and gaseous steam – digital networks manifest themselves in functional layers of physical connectivity, applications, and content, which interact with one another through technical interfaces. The unstable conversion points between forms of water are called phase transitions. The phase transitions in digital communications networks are the logical layer, which connects users and resources to networks, and the interface layer, which connects users and information to devices. Legislators and regulators traditionally ignore these "connective layers." Yet as the layered model reveals, they are central to the emerging policy challenges of a converged world. Phone numbers, Internet protocol routing techniques, and digital rights management technologies are examples of logical and interface-layer features that are determining the complexion of converged digital networks, and the business opportunities that depend on them.

A layered approach would use connective layer tools to reconceptualize traditional elements of communications policy. This would eliminate uncertainties about the legal status of voice over IP, mitigate concerns about a subsidy shortfall for rural phone customers, and lay the groundwork to address emerging competitive, governance, privacy, and other issues around digital identity. Moreover, by pinpointing these hidden chokepoints, a layered approach would reduce the overall level of regulation. Adopting the layered model would ensure that emerging technologies can flourish while creating a transition path from the communications world of the past to the converged digital universe of the future.

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I. Introduction

Telecommunications is a trillion-dollar industry undergoing a massive transformation. As technology and market developments undermine long-standing business models and value chains, existing legal frameworks are failing as well. The current structure of American communications regulation is a direct descendent of railroad laws developed in the 19th century. As we move deeper into the 21st century, such a framework is no longer tenable. Moreover, the harmful consequences of the legacy legal environment are not limited to the telecommunications sector. The Internet and nascent digital media services operate on top of communications networks. Decisions about telecommunications policy are crucial to the future of these markets as well.

Despite all this, the debate over reforming America's telecommunications laws is trapped in the assumptions of the past.[1] The primary discussion in Washington today concerns whether – and how far – to "deregulate" incumbent network operators, and whether – and how much – to "regulate" the Internet, all the while presuming a constant meaning for "regulation." Meanwhile, new technologies such as voice over Internet protocol (VOIP) create both regulatory uncertainty and significant economic dislocations. A chance in approach is warranted. That new approach must offer not just fresh policy recommendations, but an entirely new way to think about – and talk about – the challenges facing the converging telecommunications and Internet markets.

This paper maps out a new grammar for telecommunications policy. PART II analyzes the inter-connected technology, legal, and business developments responsible for the current impasse. PART III introduces the layered model, outlining prior work and further developing the concept with an analogical assist from high school chemistry. PART IV drills down on two previously under-appreciated transition points: the logical layer and the interface layer, reinterpreting historical policy initiatives in layered terms. PART V identifies some of the key questions likely to emerge in these connective layers in the future, and offers suggestions for policy-makers.

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[1] This paper focuses on the US legal environment, although the thrust of the argument is applicable globally.

II. Telecom in the Age of Convergence

The telecommunications industry is facing a dramatic upheaval thanks to one basic phenomenon: convergence.[2] In analog form, every communications medium is unique. An analog telephone call, for example, cannot be turned into a cable television broadcast. And even though a recorded telephone call could be played over a radio channel, the broadcast radio transmitter couldn't be used to send a call between just two individuals, as the phone network does countless times each day.[3]

Everything starts to change when information is transmitted in digital form. Digital communications are fundamentally just strings of ones and zeroes, and thus ultimately interchangeable. As a result, network platforms which formerly had no competitive overlap now can offer the same services. Your cable TV operator can be your phone company, while your wireless phone provider gives you Internet access, and your wired telephone company provides your television. Moreover, it becomes significantly easier for all of those platforms to add new functionality. Intelligence moves to the edges of the network, reducing the need for network-wide upgrades to core infrastructure, allowing many more companies to create new services, and taking advantage of common standards.[4] Convergence also means that, instead of expensive, proprietary equipment, telecommunications networks can use the same kinds of software and hardware as computer networks. As a result, prices fall, new competitors enter, service offerings multiply, and walls between industries collapse.[5]

The telecommunications industry that developed over the course of the 20th century, before convergence, was based on vertical integration of

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[2] For an early overview of the impacts of the Internet and convergence on the telecommunications industry and its regulation, see KEVIN WERBACH, DIGITAL TORNADO: THE INTERNET AND TELECOMMUNICATIONS POLICY (Fed. Communications Comm'n Office of Plans and Policy, Working Paper Series 29, Mar. 1997), available at http://www.fcc.gov/Bureaus/OPP/working_papers/oppwp29pdf.html.

[3] Even in analog form, all communications networks used one of two fundamental mechanisms for transmitting information: electrical signals across a wire (telephone and cable), or electrical signals across the air (radio, TV, mobile phones, and satellite). Today networks also use optical signals across both the airwaves and wires. My point is that, even though a radio broadcast and a mobile phone conversation in the analog domain have certain technical commonalities, each network is optimized and locked into a particular service. Radio equipment is designed for one-to-many broadcast, not one-to-one telephony.

[4] *See* David Isenberg, The Rise of the Stupid Network, *at* http://www.rageboy.com/stupidnet.html.

[5] *See*, Ken Belson, "Phone Line Alchemy: Copper Into Fiber," *New York Times,* Oct. 11, 2004, at C1;

the carrier function, with artificial division of traffic to reflect legacy business structures and regulatory imperatives.[6] Each phone company operated as a silo of its own. The carrier determined the suite of services it would offer to customers, and managed the internal addressing and directory processes as an integral part of those offerings. Because voice telephony was the primary purpose of the network, and could be rated in terms of time and distance, operators developed intricate billing systems to meter calls.

When carriers interconnected with one another to hand off traffic, they did so pursuant to inflated regulated rates, designed in part to maintain cross-subsidies between local and long-distance calls. Regulators could collect universal service subsidy levies from operators based on interstate revenues, because traffic was easy to segment and track. Even when the market began to change, with the end of the AT&T monopoly and the early stages of convergence, the need to preserve existing revenue and subsidy flows was a strong roadblock to any changes.

Today, technological and business trends have undermined both pillars of the old order. The layered nature of digital networks, as described below, disaggregates the vertically integrated structure of telephone companies.[7] It becomes possible to deliver voice – the core telephone offering – on top of an Internet data stream, which itself rides on top of the existing telephone transport infrastructure. This indirection, known as voice over IP, decouples telephony from network infrastructure.[8] It also makes it difficult, if not impossible, to continue splitting up and metering traffic on a geographic basis. Unlike a circuit-switched telephone call, which always has a definite origination and termination point, a VOIP communication flows over multiple indeterminate paths determined in real-time by swarms of routers.[9] Moreover, although a VOIP connection may originate and terminate at identifiable machines, those machines have no necessary connection to physical geography.

As VOIP grows, the traditional business model for telecom operators is coming under pressure.[10] Residential consumer VOIP providers such as

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[6] *See* Kevin Werbach, A Layered Model for Internet Policy, 1 J. TELECOMM. & HIGH TECH. L. 37, 58–64 (2002).

[7] See *Id.*

[8] *See* IP-Enabled Services, Notice of Proposed Rulemaking, FCC 04-28, Feb. 12, 2004; Senate Committee on Commerce, Science, and Transportation, Voice Over Internet Protocol Hearing, February 24, 2004, Testimony of Kevin Werbach, *available at* http://commerce.senate.gov/hearings/testimony.cfm?id=1065&wit_id=2993.

[9] See Digital Tornado, *supra* note 2.

[10] *See* The Phone Call is Dead; Long Live the Phone Call, *The Economist,* Dec. 4, 2004.

AT&T and Vonage charge roughly $25 per month for unlimited nationwide VOIP calls, significantly below what incumbents offer.[11] And competitive pressure is bound to drive that number lower, perhaps even zero.[12] Moreover, because VOIP is nothing more than a data application, it can be delivered entirely through application-level software.[13] The leading example of software-based VOIP is Skype, a peer-to-peer application from the same team that developed the popular Kazaa file-sharing software.[14] Remarkably, even though it uses a distributed peer-to-peer architecture and rides on shared public Internet links, Skype often provides higher-quality voice transmissions than the public switched network. Skype does not charge for basic phone calls between Skype users, since it rides on top of an existing broadband connection.[15] It also confounds the traditional linkage between telephone companies and physical geography. The software is produced by a Luxembourg company, managed from London and Stockholm, with software development in Estonia, and with a truly global user base unlike any phone company in history. As of October 2004, the software had over 12 million users worldwide, had handled over two billion minutes of traffic, and typically had over one million simultaneous online users at any given time.[16]

And Skype, at least in its current form, may be a relatively easy case for regulators to address. At least Skype is selling the familiar ability to make phone calls. Other examples of VOIP, though technically similar to Skype and Vonage, look nothing like the phone services of yesteryear. For example, Microsoft and Sony both provide built-in VOIP capabilities for their multi-player online console gaming services. Every customer of Microsoft's Xbox Live service receives a headset that plugs into the game

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[11] This cost savings is due, in part, to the fact that VOIP customers already purchase broadband Internet access. Thus, the base-level transport functionality is already paid for.

[12] If voice service were free, carriers would generate revenue through other means, such as advertising and value-added services. *See* Alex Salkever, "Phone Service the 'Zero Cost' Way," *BusinessWeek*, January 6, 2004.

[13] *See* Thomas J. Fitzgerald, Should Your PC Be Your Telephone?, *New York Times*, Dec. 2, 2004, at G1.

[14] http://www.skype.com; James Fallows, Techno Files; In Internet Calling, Skype Is Living Up to the Hype, *New York Times*, Sept. 5, 2004; Andy Reinhardt, "Net Phone Calls, Free -- And Clear; Skype's Radical Technology and Marketing Threaten the Very Foundations of Telecom", *BusinessWeek*, Nov. 1, 2004, at 60.

[15] Skype does charge a per-minute for making calls to non-Skype users, a service it calls "SkypeOut." This service works through interconnection points with the public switched telephone network. *See* Kevin Werbach, Tune In, Turn On, Skype Out, VOIP Central, July 1, 2004, *at* http://www.techcentralstation.com/070104F.html.

[16] Press Release, One Million Simultaneous Users on Skype, *at* http://www.skype.com/company/news/2004/1million_online.html.

console. Players of certain games can chat with one another across the Internet to coordinate their activities in the game, or just have a conversation. With over one million Xbox Live subscribers, this arguably makes Microsoft the largest paid voice over broadband service provider in the US. [17] Yet none of those users think of Microsoft as their phone company. Instead, XBox Live is effectively a species of instant messaging (IM). And, as it turns out, leading IM services such as Yahoo! Messenger now offer voice chat among their capabilities.

The mobile phone market provides a final vision of where the telecom industry as a whole might be going. Mobile phone usage has grown extremely rapidly, with worldwide subscribers passing landline subscribers by 2004.[18] A significant and growing number of subscribers, especially young people, use their mobile phone as their sole phone line.[19] In recent years, mobile phone operators have upgraded their networks to offer increasingly sophisticated data capabilities. Although data still represents the minority of operator revenues, it is growing significantly faster than voice revenues. Competition and network capacity growth have produced a pricing model that looks more like residential broadband than traditional phone service. Carriers originally charged high per-minute rates, but in recent years service plans have shifted almost entirely to flat monthly fees for large buckets of minutes. Moreover, ancillary services such as downloadable ringtones and games are fast becoming a significant chunk of the mobile phone business model. Ringtones alone now generate over $3 billion in annual revenue, roughly ten percent of the size of the entire global music industry.[20] It's not that farfetched to imagine a mobile phone market in the not-to-distant future where users get the calls for free, put pay for the rings.

These examples demonstrate that what it means to be telecom company is changing dramatically. A sector that used to be based on one well-defined product (phone calls), a well-defined unit of measurement (minutes), and a strong connection to physical geography is turning into

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[17] *See* Kevin Werbach, Not Your Parents' Phone System, VOIP Central, Aug. 25, 2004, *at* http://www.techcentralstation.com/082504E.html.

[18] *See* "Battling for the Palm of Your Hand - Mobile Phones," *The Economist*, May 1, 2004.

[19] *See* Michael R. Ward & Glenn A. Woroch, Usage Substitution between Fixed and Mobile Telephony in the U.S, CRTP Working Paper, October 2004, *available at* http://elsa.berkeley.edu/~woroch/usage%20substitution.pdf; Geoffrey Nairn, "The Cost of Cutting the Cord," *Financial Times*, Oct. 6, 2004. This trend has been a signficant factor in the recent decline in wireline access lines.

[20] See Jason Ankeny, "Interoperable MMS Set to Explode," *Telephony*, Nov. 8, 2004; "Music's Brighter Future," *The Economist*, Oct. 30, 2004.

something else entirely. That something is data-centric, distributed, application agnostic, self-organizing, and rapidly evolving. In other words, it is the Internet.[21]

III. The Layered Approach

The radical upheaval in telecom calls for new conceptual models.[22] The engineering concept of layers provides a useful heuristic for analyzing and answering the policy challenges of the Internet and convergence.

A. Introduction to Layers

A layered analysis divides a networked information system into a hierarchical "stack." Each layer describes a category of functionality that is self-contained, but necessary to deliver the functions available higher up. Layers are connected to one another through technical interfaces known as protocols.

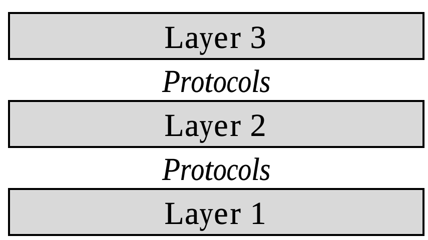

Figure 1: Simple conceptual model of layers.

Conceptually, layers can be thought of as modules.[23] Instead of a system that is tightly integrated, and delivered by a single provider as a unit, a modular structure is disaggregated into separate markets, with competition in each of them. The personal computer industry is a classic case of a modular business.[24] Dell may sell the PC to a user, but Intel

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[21] *See* Layered Model, *supra* note 6 (claiming that telecommunications policy will become a subset of Internet policy).

[22] Other scholars have recognized the need for a new approach to telecom policy. *See, e.g.* Phil Weiser, Toward a Next Generation Regulatory Regime, 35 LOYOLA L. REV. 41 (2003).

[23] I use modularity here in the sense developed by Carliss Baldwin and Kim Clark. *See* CARLISS BALDWIN & KIM CLARK. DESIGN RULES: THE POWER OF MODULARITY. (MIT Press, 2000).

[24] *See* Baldwin & Clark, *supra* note 23.

provides the microprocessors, Microsoft the operating system, Hitachi the disk drives, and so forth. Dell's primary functions are to select and integrate the component modules, and to provide customer support and other ancillary services. This market structure has proven extremely effective for promoting innovation and price/performance improvements.[25] Layers are a special case in which there is a fixed, linear relationship between the modules. Also, in a layered environment, there need not be a single integration point, analogous to Dell in the PC example, where all the modules come together into a package sold to end-users.

Engineers have understood the technical structure of the Internet in terms of layers since its earliest days.[26] A commonly used technical model is the Open Systems Interconnection (OSI) stack, which defines seven layers of functionality: application, presentation, session, transport, network, data link and physical.[27] Although the designers of the Internet declined to adopt the OSI model formally as a rigid template, it has become the de facto descriptive framework for the data networking world.

There are several technical benefits to a layered approach.[28] Layering as a design concept allows developers and providers to separate out levels of functionality, each of which can be optimized independently.[29] A service provider at one layer – say, an e-commerce retailer such as Amazon.com – need not concern itself with the mechanisms by which data moves from its servers to its customers, or the difference between telephone wires and coaxial cable for carrying data traffic. Each provider can focus on what it does best. Moreover, a market that does not depend

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[25] *See id.* Another take on this market dynamic is that the company controlling the crucial "platform" integration point has incentives not only to extract monopoly rents, but to facilitate activity and innovation by companies using the platform. *See* Philip Weiser and Joseph Farrell, Modularity, Vertical Integration and Open Access Policies: Towards A Convergence of Antitrust and Regulation in The Internet Age, 17 HARV. J. L. & TECH. (2003).

[26] See, e.g., Anthony Rutkowski, The Internet: An Abstraction in Chaos, The Internet as Paradigm (Institute for Information Studies 1997); TIM BERNERS-LEE, WEAVING THE WEB: THE ORIGINAL DESIGN AND ULTIMATE DESTINY OF THE WORLD WIDE WEB BY ITS INVENTOR 129-30 (1999); SRINIVASAN KESHAV, AN ENGINEERING APPROACH TO COMPUTER NETWORKING (Addison Wesley 1997).

[27] See JOHN D. SPRAGINS ET AL., TELECOMMUNICATIONS PROTOCOLS AND DESIGN 14-15, 118-27 (1991).

[28] *See* Layered Model, *supra* note 6.

[29] *See* Ashish Shah *et al.*, Thinking About Openness in the Telecommunications Policy Context, Paper Presented at The Thirty-First Telecommunications Policy Research Conference 13 (Sept. 20, 2003), *available at* http://intel.si.umich.edu/tprc/papers/2003/244/openness2.pdf.

on a small number of vertically integrated providers can produce greater innovation, by unlocking the potential of all market participants.[30]

Layering also establishes the competitive stage for firms that operate in and around those networks. For example, a "layer two" device[31] such as an Ethernet bridge performs only basic traffic forwarding between two machines, while "layer three" equipment such as switches and routers handle more complex tasks. A "layer four" switch adds an understanding of end-to-end network traffic flows and performance, while a "layer seven" switch differentiates among the applications the traffic is carrying. Layers effectively define the value chain through which products and services are ultimately delivered to end-users.[32] Amazon.com, as a provider of Web-based applications and content, relies on physical connections from ISPs and broadband network operators, as well as logical addressing mechanisms to ensure its information reaches its customers.

Although the layers of the communications stack are distinct, they are composed of the same basic stuff. All of the layers are, fundamentally, software code that manipulates bits of information to form a networked communications system.[33] Even the physical layer, the most rigidly fixed, includes software and protocols that define how information travels across physical links. Moreover, functions that were previously delivered at one layer may, in some cases, migrate to other layers. In the legacy public switched telephone network, basic voice communications were hard-wired into the physical infrastructure. With VOIP, they become an application that can ride on any physical-layer platform.

B. Layers and Communications Policy

Historically, communications regulation developed around a series of unconnected vertical silos.[34] Telephone networks were regulated as

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[30] Baldwin and Clark explain this value proposition in connection with modularity. *See* Baldwin & Clark, *supra* note 23.

[31] The layer numbers here are based on the OSI model.

[32] One complication is that the same functionality can sometimes be delivered at different layers. Voice over IP, an application-layer reformulation of the voice telephony functionality formerly tied to the physical layer, is an example.

[33] *Cf.* LAWRENCE LESSIG, CODE AND OTHER LAWS OF CYBERSPACE (1999) (arguing that the "West Coast Code" of software regulates online activity as much as traditional laws).

[34] I have previously described the silo model as "horizontal" and the layered model as "vertical." *See* Werbach, Layered Model, *supra* note 6. However, most other commentators find the opposite terminology more intuitive. *See, e.g., Whitt, infra* note 46. Therefore, I adopt it here. The difference is purely semantic.

"common carriers," based on models first developed in the 19th century for railroads and the telegraph.[35] Wireless communications systems were subjected to an entirely different set of regulations, designed with radio broadcasting in mind.[36] Newer communications networks, including cable television, cellular telephony, and satellite communications, were each given their own set of tailor-made rules. A federal agency, the Federal Communications Commission (FCC) regulated interstate and international communications, while many local activities fell under the purview of state public utility commissions and municipal authorities.

In the days when each network delivered a different service, using different basic technologies, this division made sense.[37] Connections started and stopped at discrete points, allowing for relatively neat geographical separations. The issues confronting telephone companies were different from those facing cable television operators, and the companies operated in distinct markets. Data services, such as they were, could be kept outside the legacy regulatory system altogether, without causing much disruption.[38]

Today, however, telephone and cable companies compete head-to-head in broadband Internet access. They will soon compete in most markets for voice telephony (traditionally the sole province of phone companies), as well as for multi-channel video programming (the traditional birthright of cable). Data represents the major growth area for most communications companies. Applications such as VOIP, which is inextricably both voice and data, straddle the legacy legal divisions. The result is a series of distortions and uncertainties, as like services are regulated differently, and as the FCC struggles to define a coherent framework within the bounds of its statutory authority.

In the past five years, legal and policy analysts have appropriated the concept of layers as a means to address these challenges.[39] A layered

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[35] *See* Adam Candeub, Network Interconnection and Takings, 54 Syracuse L. Rev. 369 (2004).

[36] *See* Kevin Werbach, Supercommons: Toward a Unified Theory of Wireless Communication, 82 TEXAS L. REV.863 (2004)

[37] *See* Layered Model, *supra* note 6.

[38] *See* Digital Tornado, *supra* note 2; Jason Oxman, The FCC and the Unregulation of the Internet (Fed. Communications Comm'n Office of Plans and Policy, Working Paper No. 31, July 1999), *available at* http://www.fcc.gov/Bureaus/OPP/working_papers/oppwp31.pdf; Robert Cannon, The legacy of the Federal Communications Commission's Computer Inquiries. 55 FED. COMM. L.J. 167-205 (2003).

[39] *See* Yochai Benkler, *From Consumers to Users: Shifting the Deeper Structures of Regulation Toward Sustainable Commons and User Access*, 52 FED. COMM. L.J. 561, 562 (2000); Jeff Mackie-

model for communications policy is a schematic of layer divisions, along with rules or guidelines for policy-makers. Layered thinking helps tackle difficult communications policy questions by separating out questions, and by revealing previously un-recognized issues. Moreover, the history of the Internet shows the value of respecting layer integrity.[40] Actions by service providers to erase the distinctions between layers tend to threaten innovation and competition.[41] Similarly, actions by regulators should be targeted to the appropriate layer for the problem at hand, to avoid unnecessary spillover effects.[42]

By shifting regulatory structures from vertical silos based on network platform to horizontal layers, the layered approach tracks the reality of convergence. The important question is not whether bits fly through the air or over a wire, let alone whether that wire is twisted pair or coax, but what is happening to those bits. A layered model defines a hierarchy of stepping stones, with basic physical connectivity on the bottom and content at the top. Every step serves as a platform for the step above it.

Layered models are becoming a common tool for analyzing questions in telecommunications policy, Internet regulation, and cyberlaw.[43] After several legal scholars developed the basic contours of the layered approach, policy advocates began to translate those arguments into concrete proposals.[44] The European Union independently used a framework similar to the layered model as the basis for its overhaul of communications regulation.[45] MCI became a particular champion of the

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Mason, Leveraging and Layering: Making Sense of Telecom, Computing and Data Market Structure, unpublished presentation to the FCC (July 23, 1996), at http://www-personal.umich.edu/~jmm/presentations/fcc96-layering.pdf; LAWRENCE LESSIG, THE FUTURE OF IDEAS: THE FATE OF THE COMMONS IN A CONNECTED WORLD 23-25 (2001); Timothy Wu, *Application-Centered Internet Analysis*, 85 Va. L. Rev. 1163 (1999); Lawrence Solum & Minn Chung, The Layers Principle: Internet Architecture and the Law, 79 NOTRE DAME L. REV. 815 (2004).

40 *See* Solum & Chung, *supra* note 39.

41 *See* Solum & Chung, *supra* note 39.

42 *See* Solum & Chung, *supra* note 39.

43 *See supra* note 39.

44 *See* Richard Whitt, Codifying The Network Layers Model: MCI's Proposal for New Federal Legislation Reforming U.S. Communications Law, March 2004, *at* http://global.mci.com/about/publicpolicy/presentations/layersmodelfederallegislation.pdf.

45 Directive 2002/21/EC of the European Parliament and of the Council of 7 March 2002 on a Common Regulatory Framework for Electronic Communications Networks and Service 2002 O.J. (L. 108). *See* Doug Sicker & Joshua Mindel, "Comparing the Layered Model for Telecommunications Policy with the EU's Newly Adopted Framework", J. TELECOM. & HIGH-TECH L., 2003; Robert Frieden, "Adjusting the Horizontal and Vertical in

layered model, developing white papers, model statutes, and other materials extolling the virtues of a layered approach.[46]

Predictably, MCI's advocacy provoked a response from the local phone companies that are MCI's traditional enemies in regulatory debates. A group called the New Millennium Research Council assembled an entire book of essays criticizing the layered model.[47] The thrust of most of the attacks is that a layered approach mandates heavy-handed regulatory disaggregation of networks into commodity components, thwarting market efficiencies.[48] Yet conceptually dividing networks into layers does not mean those layers cannot be provided by a single company. Just because MCI believes that a layered model supports is advocacy of "UNE-P" wholesale discounts for access to incumbent networks doesn't mean the two positions are identical.[49]

A great virtue of the layered approach to communications policy is that it aligns legal structures with the real world. Data networks *are* designed, deployed, and used with layers. And the infrastructure telecommunications increasingly is comprised of data networks. Virtually every phone call is already carried over a digital connection. Major carriers are beginning a slow but inevitable transition away from the circuit-switched telecom architecture dating back to Alexander Graham Bell, deploying VOIP in its place.[50] Business factors are driving this shift as much as technological ones. For the first time, wireline access lines are declining, and competition is putting pressure on telephone service margins.[51] To make up the slack, carriers are investing heavily in broadband as a new growth area[52] The plasticity of digital

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Telecommunications Regulation: A Comparison of the Traditional and a New Layered Approach," 55 FED. COMM. L.J. 207.

[46] *See* Richard S. Whitt, A Horizontal Leap Forward, Formulating A New Public Policy Framework Based On The Network Layers Model, 56 Fed. Comm. L.J. 587 (2004).

[47] Free Ride: Deficiencies of the MCI 'Layers' Policy Model and the Need For Principles that Encourage Competition in the New IP World, New Millennium Research Council, July 2004, *available at* http://www.newmillenniumresearch.org/news/071304_report.pdf.

[48] *See id.*

[49] *See* A Horizontal Leap Forward, *supra* note 39.

[50] *See supra* note 10; Bernard Simon, "A Bright New Day for the Telecom Industry, if the Public Will Go Along," *New York Times*, Jan. 12, 2004, at C3.

[51] *See* Seth Schiesel, "The Bells Struggle to Survive A Changing Telephone Game," *New York Times*, Nov. 24, 2003, at C1.

[52] *See* Julie Creswell, "Ivan Seidenberg, CEO of Verizon, Vows to Overpower the Cable Guys by Plowing Billions into a '90s-Style Broadband Buildout," *Fortune*, May 31, 2004; Ken Benson, Bells Are Catching Up In Battle for Broadband, *New York Times*, July 28, 2004.

communications – everything ultimately reduces to identical ones and zeros – means that different services can more easily be combined into packages. Add rapid industry consolidation, and the near-to-intermediate-term future of telecom looks to be a "battle of the bundles," among providers of integrated data-centric offerings.[53]

If they are to continue performing their mission, communications regulators need a way to define rules governing the industry, and to evaluate actions by industry participants. Layered models fill that role.

C. Pouring Water Through a Double-Necked Hourglass

In the past, I have described a four-layer model: physical, logical, applications, content.[54] This model, with some variations, is the most commonly used set of layers in current scholarship and policy advocacy.[55] As a conceptual tool, however, layered models need not be uniform. We need not agree completely on the best way to slice the pie, so long as we agree the pie must be sliced, and in which direction. Different conceptual models may be appropriate for different situations. For example, a layered model that serves as a blueprint for legislation might not be the best model for engineers to use in designing networks.

In this paper, I would like to develop a modified layered model. The four-layer framework is still the best compromise between accuracy and simplicity. However, it – and most of the other layered models proposed heretofore – suffers from the limitation of treating all layers equally. There is a subtle but significant difference between the roles certain layers play in the overall stack.

The modified layered model is shaped like a double-necked hourglass. Depending on one's viewpoint it has either three or five layers:

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[53] *See* Ken Belson, "Cable's Rivals Lure Customers With Packages", *New York Times,* Nov. 22, 2004, at C1; Blair Levin, The Broadband Bundle Battles Ahead, Presentation to the Council for Entrepreneurial Development, Oct. 8, 2004, *available at* http://www.cednc.org/conferences/infotech/2004/speakers/blair_levin.ppt; Sandra Ward, Battle of the Nets: An Interview with Blair Levin, Barron's, July 18,2003.

[54] *See* Layered Model, *supra* note 6

[55] *See, e.g.*, Benkler, *supra* note 39; Lessig, *supra* note 39; Whitt, *supra* note 46.

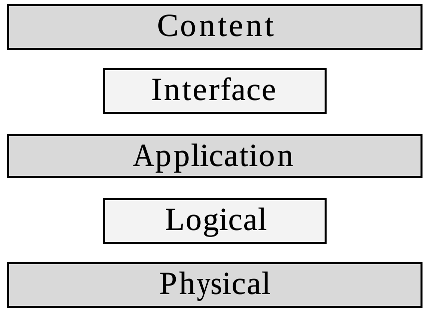

Figure 2: Revised layered model.

The PHYSICAL layer is the baseline infrastructure that transports bits from place to place.[56] It is the physical "roadbeds" of the information superhighway: the twisted pair copper loops, coaxial cables, fiber optic lines, radio transmissions, and other carrier technologies. It also includes the associated software that defines how bits are organized across those carriers. It can be called the "where" layer.

A step up is the LOGICAL layer, which is the "who." The logical layer ensures that the right bits get to the right place.[57] It therefore includes identity and identifier information, such as phone numbers and other addresses, which allows the network to know where bits should flow.

Next is the APPLICATION layer, the "why." Applications define the ways information is used. They produce the valuable functionality, whether it be sharing photographs or real-time voice conversations, that the network delivers. Voice telephony, in a data-centric network, resides at the application layer, as does AOL's instant messaging service and eBay's virtual marketplace.

Above that is the INTERFACE layer, the "how". Interfaces are how users interact with applications. One type of interface is physical: the standards for connecting devices to the network. This layer also includes the operating system software that manages applications on the user's local computer, as well as hooks between that device and the rest of the network.

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[56] A bit, as defined by Claude Shannon in his foundational works on information theory, is the basic unit of digital information. *See* Claude Shannon, A Mathematical Theory of Communication, 27 Bell Sys. Technical J. 379 and 623 (1948), *available at* http://cm.bell-labs.com/cm/ms/what/shannonday/shannon1948.pdf. It is typically represented as a counter that can show either zero or one. Bits are distinguished from atoms, the units of physical entities. *See* NICHOLAS NEGROPONTE, BEING DIGITAL (Vintage 1996).

[57] I use the term "logical layer" in a slightly different way than Benkler and Lessig. They use it to describe all the software code in the network, as distinguished from the physical hardware. *See* Benkler, *supra* note 39; Lessig, *supra* note 39.

As will be discussed below, digital rights management looms as a significant area of interface-layer communications regulation.

Finally, the CONTENT layer is the "what." It is the content of the phone calls, the text of Web pages, the books purchased on Amazon.com, and the music transferred to an iPod. The content layer is largely unregulated, with the large exception of over-the-air radio and television broadcasting.

The salient feature of the modified layered model is that it distinguishes between two kinds of layers: functional and connective. The three functional layers – content, application, and physical – represent the primary services delivered to end-users. The two connective layers – interface and logical – face inward, toward the other parts of the network. Their primary mission is to interconnect the layers above and below. As such, these connective layers are often viewed as merely "glue:" behind-the-scenes code that performs un-interesting clerical or logistical functions. Nothing could be further from the truth. As will be discussed below, the connective layers are, in fact, the most crucial points in the communications system stack for purposes of public policy. Communications policy heretofore has largely concerned itself with the functional layers and ignored the connective layers. In the future, that balance should be reversed.

The chemical properties of water represent a good analogy to this layered communications system. Water, as most people remember from high-school chemistry, is a substance comprised of two hydrogen and one oxygen atom. Depending on temperature, water exists in three forms: solid, liquid, and gaseous. The solid is ice; the liquid is water; and the gas is steam. Though chemically identical, the three phases exhibit very different physical properties. To an observer, it is far from obvious that ice, water, and steam are even related.

Between the three states of water are two "phase transitions," where water changes from one form into another, known as the boiling point and the melting. The system therefore mirrors the connective layers of networked communications systems described above:

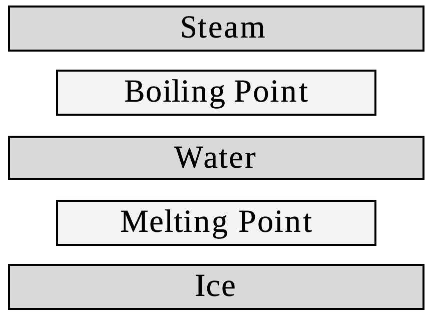

Figure 3: Physical states of water.

Phase transitions are points of rapid change. Physical properties shift dramatically once key temperature thresholds have been passed.[58] The boiling point and melting point of any substance are important identifying characteristics, because they shape the practical uses of the substance and also reveal aspects of molecular structure.

D. *The End of the Ice Age*

The water analogy helps to illustrate the differences among layers in the data communications stack. Ice and steam are both forms of the same substance, but their properties vary dramatically. Similarly, all layers of the communications policy stack are essentially software code, but they exhibit very different features. The physical layer, like ice, is the most rigid. It is tied to lines and switches located in particular physical locations, and subject to particular technical constraints. Being built more on atoms than bits, the physical layer subject to somewhat different economic factors than the layers above. It the domain of high fixed costs, creating a tendency toward natural monopoly.[59] Moreover, because each higher layer encapsulates and abstracts the activity below, it is some degree dependent on the lower levels to a greater degree than the reverse is true.

As a result, the physical layer has historically been the focus of communications regulation. It is the easiest to identify, and the clearest source of market power. The FCC, for the most part, regulates owners of

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[58] Careful procedures can produce strange intermediate states such, but these are artificial.

[59] High fixed costs relative to variable costs mean that there are likely to be significant economies of scale. This gives larger players an advantage, and can create a feedback loop that fosters monopolies. See Eli Noam, How Telecom is Becoming a Cyclical Industry, And What To Do About It, June 28, 2002, *at* http://www.citi.columbia.edu/elinoam/articles/cyclicality.htm.

physical networks, not the users of those networks. In the world of telephony, it regulates providers of "telecommunications," which essentially means transmission.[60] The owners of the physical networks are the ones providing that transmission function. The FCC does not directly regulate customers of those networks, which is why the classification of "enhanced services" providers as network customers freed them from regulation.[61] Similarly, in wireless communication, the FCC oversees the allocation and use of spectrum frequencies, the physical infrastructure of the air, and the associated transmitters that operate in those frequencies. It has not traditionally exercised direct regulation over receivers, such as television sets.[62]

The Commission's proclivity toward regulating the physical layer continued amid the early stages of convergence. Even though DSL and cable modem service are direct competitors in many markets, the FCC treated each under entirely separate legal rules.[63] It required DSL operators to provide "unbundled network elements" to competitors, and to offer "line-sharing" specifically for independent providers of DSL.[64] There were good competitive and legal reasons for these steps. However, at the same time, the Commission continued to treat cable modem service under the rules governing cable television, which has no unbundling obligations.[65] This decision, again supported by good legal and policy rationales, created a clear arbitrage situation. Phone companies had every

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[60] "The term 'telecommunications' means the transmission, between or among points specified by the user, or information of the user's choosing, without change in the form or content of the information as sent and received." 47 U.S.C. § 153(43) (Supp. V 1999).

[61] *See* MTS and WATS Market Structure, *Memorandum Opinion and Order*, 97 F.C.C.2d 682, 711-22 (1983); Digital Tornado, *supra* note 2, at 50.

[62] *See* FCC Spectrum Policy Task Force Report, ET Docket No. 02-135 (FCC Nov. 15, 2002), *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-228542A1.pdf.

[63] The Commission, to be fair, had little leeway on this matter. The Telecommunications Act of 1996 largely preserved the silo-oriented framework of the 1934 Communications Act. *See* Layered Model, *supra* note 6.

[64] *See* Implementation of the Local Competition Provision of the Telecommunications Act of 1996, CC Dkt. 96-98, Third Report and Order and Fourth Further Notice of Proposed Rule Making, 15 FCC Rcd. 3696 (1999) (establishing rules for unbundled network elements); Deployment of Wireline Services Offering Advanced Telecommunications Capability and Implementation of the Local Competition Provisions of the Telecommunications Act of 1996, CC Dkt Nos. 98-147, 96-98, Third Report and Order in CC Dkt. No. 98-147 and Fourth Report in CC Dkt. No. 96-98, 14 FCC Rcd. 20912, 20916, para. 5 (1999) (requiring line sharing)

[65] *See* Barbara Esbin, Internet Over Cable: Defining the Future In Terms of the Past, FCC Office of Plans and Policy Working Paper No. 30, August 1998, *available at* http://www.fcc.gov/Bureaus/OPP/working_papers/oppwp30.pdf.

incentive to roll back unbundling obligations on their data offerings, while cable companies had a strong incentive to block efforts to impose unbundling obligations on their offerings.

The first significant battle over the physical layer began in late 1998, under the rallying cry of "open access."[66] As cable operators built out their broadband infrastructure, advocates, including myself, argued they should be required to allow independent Internet service providers access to their networks. The argument was that the open platform model used for the phone network had been the foundation for the Internet's spectacular growth.[67] Open access to networks not only fostered innovation by small new entrants, it created a virtuous circle that benefited incumbents as well. Allowing cable operators to build closed into their physical plant would forever foreclose that kind of open connectivity in the cable broadband environment, which, then and now, represents the largest share of residential broadband customers.[68] Moreover, once cable had established its freedom from open access, phone companies were bound to push hard for similar rules as a matter of competitive parity.[69] And that is precisely what happened.

When Michael Powell took over as FCC Chairman in 2001, he made clear his desire to eliminate many of the unbundling requirements and wholesale pricing restrictions on incumbent local phone companies.[70] Powell pushed through FCC decisions in separate proceedings classifying both DSL and cable modem offerings as unregulated "information services," meaning they were not subject to unbundling requirements.[71] As

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[66] *See* Mark Lemley & Lawrence Lessig, The End of End-to-End: Preserving the Architecture of the Internet in the Broadband Era, 48 UCLA L. REV. 925 (2001); Mark Cooper, Open Access to the Broadband Internet: Technical and Economic Discrimination in Closed, Proprietary Networks, 71 U. COLO. L. REV. 1011 (2000); Kevin Werbach, The Architecture of Internet 2.0, Release 1.0, February 1999. One reason for the virulence of the open access debate in 1998-2000 was AT&T's acquisition during that time period of TCI and MediaOne, two of the largest cable television operators. The fear at the time was that AT&T would use its leverage as the largest cable player against unaffiliated service providers. As it turns out, AT&T's strategy failed for business reasons, and the company later sold its cable assets to Comcast.

[67] *See* Architecture, *supra* note 66.

[68] *See id.*

[69] *See id.* This point addressed the argument of cable operators that, even if the cable broadband platform was proprietary, competing ISPs had the option of reaching their customers through interconnection with the phone network. *See* James Speta, The Vertical Dimension of Cable Access, 71 U. COLO. L. REV. 975, 1004-07 (2000).

[70] Yochi Dreazen, FCC's Powell Quickly Marks Agency as His Own, *Wall Street Journal*, May 1, 2001, at A28; Paul Krugman, "Digital Robber Barons?", *New York Times*, Dec. 6, 2002.

[71] *See*, Appropriate Framework for Broadband Access to the Internet over Wireline Facilities, Notice of Proposed Rulemaking, 17 F.C.C.R. 3019 (2002) (concerning DSL

with the Commission's previous decisions, Powell could claim a strong public policy foundation for his actions. The previous unbundling requirements were blamed for facilitating the vast capital destruction of the telecom bust. The FCC's earlier decisions had been rejected by courts repeatedly.[72] Incumbents complained that they had no economic incentive to invest in new infrastructure if they had to share the benefits with competitors, while the erstwhile competitors who supposedly benefited from the policy were filing for bankruptcy at a rapid pace.

Unfortunately for Powell, his actions proved both politically and legally difficult to sustain. In *Brand X Internet Services v. FCC*, the Ninth Circuit rejected the FCC's conclusion that cable modem offerings are unregulated information services.[73] The FCC's efforts to fix the telephone unbundling rules created similar confusion when a dissident block of Commissioners were able to reverse Powell's proposed decision, only to have the subsequent order – itself a response to a judicial remand – overturned by the courts.[74]

Meanwhile, a new concept, network neutrality, began to enter the communications policy debate.[75] Unlike open access, which focused on physical interconnection with Internet service providers, network neutrality considers whether network operators can block or disadvantage competing providers of higher-level functionality. Specifically, the concern is that broadband providers, seeking to capture rents, will restrict users' ability to run applications, access resources, transmit content, or connect

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service); Inquiry Concerning High-Speed Access to the Internet over Cable and Other Facilities., Declaratory Ruling and Notice of Proposed Rulemaking, 17 F.C.C.R. 4798 (2002) (concerning cable modem service).

[72] United States Telecom Ass'n v. FCC, 290 F.3d 415 (D.C. Cir. 2002), *cert. denied sub nom*. WorldCom, Inc. v. United States Telecom Ass'n, 123 S. Ct. 1571 (2003).

[73] *See* Brand X Internet Servs. v. FCC, 345 F.3d 1120 (9th Cir. 2003). The decision was based largely on the application of *stare decisis* to an earlier Ninth Circuit decision finding cable modem service to be a "telecommunications service." *See* AT&T Corp. v. City of Portland, 216 F.3d 871 (9th Cir. 2000). The *Brand X* decision is now being appealed to the Supreme Court.

[74] *See* Review of the Section 251 Unbundling Obligations of Incumbent Local Exch. Carriers, Report and Order and Order on Remand and Further Notice of Proposed Rulemaking, 18 F.C.C.R. 16978, (2003), *reversed,* USTA v. FCC, No. 00-1012, 2004 WL 374262, slip op. at 11-26, 34-46 (D.C. Cir. 2004).

[75] *See* Timothy Wu, Network Neutrality, Broadband Discrimination, 2 J. TELECOMM. & HIGH TECH L. (2003); Declan McCullagh, Tech Companies Ask for Unfiltered Net, News.com, Nov. 18, 2002, *at* http://news.com.com/2100-1023-966307.html?tag=fd_top (describing network neutrality advocacy by the Coalition for Broadband Users and Innovators, a group of technology companies including Microsoft).

devices that are not affiliated with the broadband provider itself.[76] Chairman Powell has stated forcefully that broadband providers should not interfere with what he calls the Internet's "Four Freedoms": end-users' freedom to access content, use applications, attach personal devices, and obtain service plan information.[77] However, he has so far resisted calls to make that policy mandatory.[78] As with open access, broadband operators claim they need the ability to bundle services, and disclaim any intention to limit user choice.

The root problem the FCC faces in the unbundling mess is that there simply is no good answer under the current regulatory paradigm.[79] The silo-based classification into telecommunications and information services is a blunt instrument. Either something is "telecommunications" – and subject to the full panoply of FCC regulation – or it is and information service – and thus in a vaguely defined zone of "unregulation."[80] That creates strong pressure to keep as much as possible out of the telecommunications abyss. This decision, moreover, is essentially a muddled layering exercise. Under the 1996 Act, "telecommunications" essentially represents physical transmission, and "information services," which are offered "via telecommunications" represent some combination of higher-level functionality.[81] However, because the statute doesn't subdivide the network stack further, or provide any guidance for the treatment of non-telecommunications services, the decision is always subject to challenge. The Ninth Circuit did precisely that in *Brand X*, rejecting the FCC's conclusion that cable modem offerings were fundamentally information services.[82]

In essence, the legacy regulatory structure harbors a nascent two-layer framework.[83] The bottom half, the physical layer, is heavily regulated,

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[76] *See Id.*

[77] Michael Powell, Remarks at the Fall 2004 Voice on the Net conference, October 19, 2004, *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-253325A1.pdf; Michael Powell, "Preserving Internet Freedom: Guiding Principles for the Industry," Remarks at the Silicon Flatirons Symposium, Feb. 8, 2004, *at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-243556A1.pdf.

[78] *See id.*

[79] For a different approach that addresses many of the same questions, see Weiser & Farrell, *supra* note 25.

[80] *See* Layered Model, *supra* note 6. For a detailed analysis of the FCC's "unregulation" policy, see 80.

[81] 47 U.S.C. § 153(20, 43) (Supp. V 1999).

[82] *See* Brand X, *supra* note 73.

[83] *See* Layered Model, *supra* note 6.

while the upper half is regulated only in specific, well-defined cases. Broadcast media content, for example, is regulated under public interest and indecency guidelines because of its pervasiveness and its association with government-granted spectrum licenses.[84] Cable TV programming is subject to pro-competitive regulation under the 1992 cable act, to address concerns about market power in the video programming market.[85] These are essentially special-case regulations of the content layer. The interface, application, and logical layers are essentially ignored under the current statutory scheme. That is one reason issues such as open access are so troublesome. Most of the concerns about anti-competitive behavior by physical network owners concern leveraging that physical-layer dominance not just into content, but through the other layers in between.[86] There is no good way to analyze problems at the logical layer in a regime that does not acknowledge that layer exists.

Moreover, layer-violating activity does not necessarily proceed in one direction. The legacy regulatory structure, by treating the physical layer as the place to impose regulation, implies that layer is the necessary source of anti-competitive activity. While that is certainly a possible scenario, it is not the only one. The program access rules in the 1992 Cable Act, for example, were designed to prevent cable operators from using their dominance of certain high-value content to prevent competition at the physical layer, from competitors such as direct broadcast satellite providers.[87] Similar concerns arise in the United Kingdom, where there have been accusations that Rupert Murdoch is using his control over valuable sports content to block competition by cable against his BSkyB satellite service.[88]

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[84] *See* Red Lion Broadcasting Co.. v. FCC, 395 US 367 (1969) (explaining "pervasiveness" rationale); FCC v. Pacifica Foundation, 438 US 726 (1978) (upholding indecency regulation); Nat'l Broad. Co. v. United States, 319 U.S. 190 (1943) (authorizing content regulation on the basis of scarcity of spectrum)

[85] Cable Television Consumer Protection and Competition Act of 1992, Pub. L. No. 102-385, 106 Stat. 1460 (codified in scattered sections 47 U.S.C. §§ 521-611 (Supp. V 1993)).

[86] The potential use of deep packet inspection at the logical layer is an example. *See infra*.

[87] *See* David Waterman, Vertical Integration and Program Access in the Cable Television Industry, 47 FED. COMM. L.J. 511 (1995); David J. Saylor, Programming Access and Other Competition Regulations of the New Cable Television Law and the Primestar Decrees: A Guided Tour Through the Maze, 12 CARDOZO ARTS & ENT LJ 321 (1994).

[88] *See* John H. Barton, The International Video Industry: Principles For Vertical Agreements And Integration, 22 CARDOZO ARTS & ENT LJ 67 (2004),

The issues become even harder in the future. A company such as Microsoft could use its dominance of the operating system, an artifact of the interface layer, to exercise market power over both content above and everything below.[89] Or a company such as VeriSign, which controls key logical-layer assets associated with the domain name system and the ENUM protocol for translating between phone numbers and Internet addresses, could exert market power up and down from its leverage point.[90] There is simply no way to even analyze such competitive issues under the current communications policy framework. Neither Microsoft nor VeriSign controls any physical infrastructure. Neither is a carrier under any reasonable definition. Yet, under some scenarios, both could exercise a level of market power that raised the same public policy concerns as the physical layer carrier networks the Commission has long regulated.

What is needed, therefore, is not just a layered model, but a way of thinking about telecommunications policy that doesn't presuppose a hard division between a regulated physical layer and everything else. In the "Ice Age" of telecommunications, through most of the 20th century, the physical layer was a reasonable proxy for the kind of market power that necessitated regulation. The competitive issues of today and the future, however, are different.

IV. The Connective Layers

A. Making the Connective Layers Primary

Historically, communications policy has failed to acknowledge the connective layers. In fact, legacy communications regulation collapses the layered model entirely, by regulating applications (such as voice telephony and broadcast video) through differential treatment of physical-layer networks. This approach quickly breaks down when the same application (such as VOIP) runs on any transport platform. A less-obvious consequence of convergence, however, is the growing significance of the connective layers. When networks are no longer separated from one another, the key to seamless delivery of services is the connective tissue among networks, identity, and user experience.

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[89] *See* Alex Salkever, "Microsoft: Your Next Phone Company?" *BusinessWeek*, March 2, 2004; "Microsoft's Full-Court Broadband Press," *Telecom Policy Report*, Nov. 17, 2004, *available at* http://www.findarticles.com/p/articles/mi_m0PJR/is_44_2/ai_n7586312.

[90] *See* Kevin Werbach, "The Microsoft of VOIP?," *VON Magazine*, forthcoming March/April 2005.

A successful next-generation communications regulatory framework must incorporate effective targeting. In other words, law should concentrate on the most efficient leverage points for effecting public policy objectives. The silo model of regulation presupposes that physical infrastructure is the source of market power, and that high-level categorization decisions should trigger a laundry list of regulatory obligations. In both cases, the regulatory obligations involved may have been reasonable for the problem and market environment they were originally designed to address. Now, however, they create significant distortions and strong incentives for regulatory arbitrage.

The layered model reveals two critical leverage points – the connective layers – that have not traditionally factored into communications policy. Neither one does much of anything that users see. Yet, as discussed above, both are increasingly important competitive control points. In the silo model of regulation, the Commission is often forced either to regulate heavily, or not at all. The open access debate is a good example. Because the issue was framed in terms of market power based on physical infrastructure, the issue before the FCC was whether to mandate physical layer network unbundling and mandatory interconnection with unaffiliated ISPs. The cable operators and their supporters understandably made the case that any such mandated open access would inevitably force the Commission to establish regulated prices, terms, and conditions.[91] The return to such interventionistic price regulation would have been at odds with the process of deregulation the Commission has undertaken for the past twenty years. By importing mandatory interconnection concepts from the telephone world, it also would have conflicted with the silo model and its embodiment in the Communications Act, under which different networks are subject to different rules and obligations.

So the Commission rejected open access. Only later has it become apparent that the real threat from closed broadband networks is not their ability to disadvantage unaffiliated ISPs, but their ability to foreclose innovation and competition on top of the network. Open access was a case of horizontal foreclosure, involving two participants operating at the same layer. Even under such conditions, ISPs still have some alternatives, including interconnecting with DSL providers, using wireless to route around incumbent last-mile infrastructure entirely, and negotiating access arrangements privately.

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[91] *See* James B. Speta, *Handicapping the Race for the Last Mile? A Critique of Open Access Rules for Broadband Platforms*, 17 YALE J. ON REG. 39 (2000).

More worrisome is the possibility of vertical distortions. When a company that dominates one layer of the broadband communications stack forecloses or disadvantages innovation at other layers, users lose out entirely. They simply cannot get the functionality they might otherwise receive, unless they can find a complete substitute for the competitive bottleneck. This makes network neutrality in many ways more critical than open access.[92]

When network operators provide their own applications and content, they do not necessarily crowd out competitors. Because the Internet is an open platform, their offerings can compete with those non-facilities-based providers. Comcast can strike a deal with Barnes & Noble to refer customers to the BN.com online bookstore through its customer portal, but customers are always free to ignore that link and use their Web browser to go directly to Amazon.com. Even bundling of the higher-level offerings with the physical access doesn't necessarily raise competitive concerns. SBC's partnership with Yahoo! for DSL access and content, though apparently beneficial for both parties, hasn't foreclosed opportunities for innovation and competition by competitors at either level. Not so, however, if the connective layers are involved. If SBC's DSL service were bundled at the interface layer with Microsoft's Windows Media technology for rich media and digital rights management, it would create a roadblock to competing technologies.[93]

Moreover, a focus on the connective layers would reduce the aggregate level of regulation. Openness at these two key chokepoints would ensure sufficient competition to allow for less regulatory intervention at other layers. To take one example from the world of cellular telephony, Qualcomm owns key patents in a technology called Code Division Multiplexing (CDMA), which is used by many digital cellular networks. CDMA is proprietary, giving Qualcomm a powerful and lucrative position. Nonetheless, Qualcomm's dominance at the physical layer does not necessarily create the kind of market power that calls for regulation. Logical layer interconnection of mobile phone networks is open, thanks to standards-based telephone numbers and SS7 signaling networks. Application layer interconnection is also widely available, though, for

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[92] *See* Wu, *supra* note 75.

[93] If SBC simply offered the Windows Media Player software to its customers, that would constitute applications layer functionality. Customers could always download and use competing media players. If, however, the media player and its associated digital rights management technology were embedded in the interface layer, it would be tightly coupled with the broadband access service itself. It might be difficult or impossible to use competing technologies.

example, roaming arrangements among SMS text messaging services and competing application software platforms such as Microsoft's Windows Mobile, Nokia's Series 60, PalmSource's PalmOS, Sun's Java J2ME, and Qualcomm's own BREW.

B. Historical Cases

Although the FCC and other governmental entities haven't expressly acknowledged the layered nature of the networks they are addressing, they have at times taken steps targeted to the connective layers, in particular the logical layer. These actions have a mixed track record. A review of historical cases shows that delving deeply into the logical layer and directly organizing markets or protocols is dangerous, but policing the logical layer as a competitive boundary is generally effective.

1. Network-attached equipment (Part 68)

Until 1968, AT&T and its affiliated telephone companies had provisions in their tariffs prohibiting "foreign attachments" to the network.[94] In other words, users could not plug in anything not specifically approved by the phone company. At the time, AT&T was the dominant monopoly provider of both local and long-distance phone service for the vast majority of Americans. The foreign attachment rules thus effectively prevented the creation of a third-party market for phone equipment such as telephone handsets. Customers could purchase only from AT&T's affiliated manufacturing arm, only on a monthly rental basis, with no ability to add additional features.

All that changed with the adoption of the FCC's *Carterphone* rules in 1968.[95] As recently as 1956, the FCC had upheld the use of the foreign attachment rules to prohibit the sale of the Hush-a-phone, a simple rubber cup that fit on a telephone receiver to provide greater privacy.[96] By 1968, however, the winds had shifted. Presented with the Carterphone, a device for patching wireline telephone calls into a two-way wireless radio connection, the Commission reversed its prior decision.[97] Not only did it

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[94] Use of the Carterphone Device in Message Toll Telephone Services, 13 F.C.C. 2d 420 (1968), *recon. denied*, 14 F.C.C. 2d 571 (1968).

[95] *See Carterphone, supra* note 94.

[96] *See* Hush-A-Phone Corp. v. United States, 238 F.2d 266, 268 (D.C. Cir. 1956). The Commission's – and AT&T's – rationale was that the Hush-a-Phone could slightly distort the sound that the other party in the conversation heard. This was considered "harm to the network," equivalent to electrical manipulation that could injure phone company personnel or damage phone company equipment.

[97] *See Carterphone, supra* note 94.

find the Carterphone no threat to the phone network, it struck down all the foreign attachment provisions as anti-competitive. In their place, the FCC created the Part 68 rules, which governed the end-user phone equipment market for more than 30 years.[98]

The Part 68 rules are an example of interface-layer regulation. The FCC set the terms under which users and their "content" (speech) could connect to the voice application that defined the phone network. In fact, it was Part 68 that arguably created the interface layer in communications networks. Without it, everything up to and including the equipment at a user's premises was an extension of the physical network and its hidden logical interfaces. Once the connective interface layer was created through Part 68, the content and application layers followed. Only with a choice of equipment could users specify different applications or alternate forms of content.

Part 68 was thus a success story for regulation of the interface layer. Two characteristics of the FCC's action stand out: it was user-empowering, and it involved clear guidelines and well-understood technical standards. Part 68 intervened in the logical layer to give users more choices, and to create more opportunities for manufacturers selling to those users. It expanded opportunities rather than reducing them. Furthermore, Part 68 was implemented in a way that minimized possibilities for confusion and regulatory gamesmanship. The rules themselves included technical drawings to assist would-be equipment vendors. The standards for connecting equipment were derived from existing internal AT&T interfaces, preventing any requirement of network re-engineering. Manufacturers could use a streamlined process, largely involving self-certification, to put their products into the market. And Part 68 replaced the blanket prohibitions in the foreign attachment tariff provisions with a limited set of conditions that would justify rejection of a device – primarily direct physical harm to phone company employees or equipment.[99]

Part 68 made possible a network equipment business that today generates billions of dollars in annual revenues. Even more important, it opened up the possibility of attaching devices to the phone network that offered new and different functionality. Fax machines, answering

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[98] In 2000, the FCC found there was no need for the government to continue to manage the technical standards for phone equipment, because the market was sufficiently robust and competitive. Therefore, it devolved its authority to a private standards body. *See* 2000 Biennial Review of Part 68 of the Commissions Rules and Regulations, FCC 00-400, Report and Order (Dec. 21, 2000),

[99] 47 C.F.R. §§ 68.1-.506 (1992).

machines, and computer modems are all children of Part 68.[100] The consumer Internet could not have happened if users didn't have the ability to attach devices to their telephone lines that transformed the phone network into a channel for data communications.

2. The Computer Inquiries

The *Computer III* rules are another example of successful regulation of the connective layers. The FCC's *Computer Inquiry* line of proceedings began in the late 1960s and continues to this day.[101] *Computer I* created an initial, flawed model for the treatment of computer processing functions in the phone network.[102] *Computer II* established a new framework that distinguished unregulated "enhanced services" from the regulated "basic services" the phone companies provided.[103] This division was, in an unacknowledged, way, the FCC's first foray into layered policy-making. The basic/enhanced distinction essentially tracked the division between the content, interface, and application layers on one side, and the logical and physical layers on the other. Network operators could not use their control over the lower layers to preclude competition at the higher layers, nor would the FCC impose the same regulatory obligations on companies operating at the higher levels as it traditionally had on phone companies.

Computer II imposed "structural separation" of enhanced services provided by the incumbent Bell Operating Companies.[104] They could only offer enhanced services through wholly separate subsidiary companies, through arms-length relationships, in order to safeguard against anti-competitive behavior. *Computer III* left the basic framework in place, but shifted to non-structural safeguards such as Comparably Efficient Interconnection (CEI), which required phone companies to document and make available to competitors any basic services they used for their own enhanced services.[105]

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[100] *See* Tim Wu & Lawrence Lessig, Ex Parte Submission in CS Docket No. 02-52, August 22, 2003, *available at* http://faculty.virginia.edu/timwu/wu_lessig_fcc.pdf.

[101] *See* Cannon, *supra* note 38.

[102] Regulatory and Policy Problems Presented by the Interdependence of Computer and Communications Services, Final Decision and Order, 28 F.C.C.2d 267 (1971).

[103] Second Computer Inquiry, Final Decision, 77 F.C.C.2d 384 (1980)

[104] *See id.*

[105] Amendment of Sections 64.702 of the Commission's Rules and Regulations. (Third Computer Inquiry), Report and Order, 104 F.C.C.2d 958 (1986); Computer III Further Remand Proceedings: Bell Operating Company Provision of Enhanced Services, Order, 14 F.C.C.R. 21628 (1999) (Computer III Further Remand Order).

Just as Part 68 helped make the Internet possible by giving users the opportunity to connect data communications devices to the network, *Computer III* did the same by giving Internet service providers the opportunity to route their data traffic easily over the phone network.[106] Where Part 68 operates at the interface layer, the *Computer III* rules work at the logical layer, ensuring that applications are able to work across existing physical networks. The *Computer III* rules, like Part 68, are credited for spurring innovation and competition. However, because *Computer III*'s non-structural safeguards involve a great deal of complexity and ongoing FCC management of interconnection terms, the implementation road has been bumpier. The courts have vacated and remanded some of the FCC's implementation decisions for not providing sufficient justification.[107]

The Commission experienced even greater difficulty with Open Network Architecture (ONA), which was supposed to be the follow-on to *Computer III*'s safeguards.[108] With ONA, the FCC envisioned breaking up the telephone network into modular components. Phone companies would make new modules available on request by independent enhanced service providers, with a private process available to resolve potential technical disputes. The ONA vision was, in short, to turn the phone network into a truly modular system.[109] It represented a bold effort to re-architect the telecom industry through an open logical layer, which would be the entry point for new innovations and competitive opportunities.

ONA never really got off the ground.[110] It was an inspiring vision, but in practice implementation was a nightmare. Phone companies rejected requests for new modules, claiming excessive technical and economic burdens relative to the demand level. Enhanced service providers felt the phone companies were stonewalling, deliberately frustrating the FCC's intentions. Both sides went back to the Commission, seeking clarifications and modifications. In the end, although the phone companies did file the required ONA plans and make some changes to their network architecture, the vision of a modular phone network was never realized.

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[106] *See* Cannon, *supra* note 38.

[107] California v. FCC, 39 F.3d 919 (9th Cir.), *cert. denied*, 514 U.S. 1050 (1994). Specifically, the court found the FCC had not sufficiently justified the elimination of *Computer II* structural safeguards.

[108] *See* Computer III Further Remand Order, *supra* note 105, para. 8 n.17 (defining ONA).

[109] *See* Baldwin & Clark, *supra* note *23*.

[110] Chris L. Kelley, *The Contestability of the Local Network: The FCC's Open Network Architecture Policy*, 45 FED. COMM. L.J. 89 (1992).

The lesson here is that regulation that requires detailed supervision and technical implementation may not be worth it, even when the objective of that regulation is worthwhile. Many of the benefits expected for ONA are starting to be realized today through VOIP, which generally operates at the higher application layer, independent of the network operators. The phone network is indeed advancing towards a more modular system, but it is happening more gradually, based on economic decisions of the network providers.

The problem with the fully modular ONA vision is that it sounds to phone companies much the way Napster sounds to record companies. If everything is broken up, modularized, standardized, and commoditized, the traditional opportunities for revenue generation and competitive differentiation go away. The fact that end-users pay less in a world where infrastructure providers make no money is cold comfort for those infrastructure providers. They can be expected to fight any effort perceived to put them in that position, not just at the FCC, but in implementation.

3. Numbering and Addressing

A final example of existing regulation in the connective layers is numbering. Phone numbers are the identity mechanism of the legacy telephone network. Numbers are subject to a technical standard, E.164, and to overlapping national, supra-national, and international regulatory mechanisms.[111] The FCC oversees the process of assigning numbers in the US, under a regional organization called the North American Numbering Plan.[112] At the highest level the International Telecommunications Union (ITU), a UN agency, defines global numbering policy through its governmental members.

Numbering sounds like a mundane and mechanical area. In reality, it raises a host of important policy issues. Without a number, a connection to the phone network is meaningless. Numbers as standard, unique identifiers make it possible for any new phone subscriber to connect to any other subscriber anywhere, regardless of service provider or location. There are, however, only so many valid phone numbers. Exhaustion of

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[111] International Telecommunication Union Telecommunications Standardization Sector ("ITU-T"), ITU-T Recommendation E.164, The International Public Telecommunication Numbering Plan (May 1997), *available at* http://www.itu.int/itudoc/itu-t/rec/e/e164.html.

[112] *See Telephone Number Portability*, CC Docket No. 95-116, First Report and Order and Further Notice of Proposed Rulemaking, 11 FCC Rcd 8352, 9393 (1996) (Number Portability Order) at n.1.

available numbers in an area forces either an overlay of a new area code – which creates confusion since neither code has a unique geographical location – or a split of the existing area code – which forces a large number of subscribers to change their phone numbers. Both steps are thus controversial, and raise competitive concerns. Moreover, numbers are valuable as advertised contact points for businesses. Yet, technically, subscribers do not own phone numbers.[113] The numbers are a public resource, managed by carriers and loaned to subscribers.

Finally, numbers are a source of competitive lock-in. If you have to change your phone number in order to switch carriers, you will be much less likely to switch. For that reason, the FCC required long-distance number portability (known as "equal access") when it implemented the AT&T breakup, and the 1996 Communications Act required local number portability to enable competition for local phone service.[114] The Commission has also recently supervised the implementation of wireless number portability for mobile phone carriers.[115]

The hidden difficulties of number assignment became apparent when toll-free "800" numbers came near exhaustion. AT&T developed toll-free calling in 1967, and it was a huge hit. Today, toll-free calls represent mor than half of US long-distance traffic.[116] By 1995, almost all the available 800 numbers had been assigned. The FCC established a process to open up a series of new toll-free area codes, starting with 888.[117] The problem was that many businesses associated their brands and goodwill with their 800 numbers, either through the number itself, or through a mnemonic association such as 1-800-FLOWERS. A company that spent millions of dollars building brand equity in its phone number, and seeing it as a key intangible asset, wouldn't take kindly to some other business obtaining the equivalent 888 number. So the FCC created a process to allow businesses with valuable numbers to free the equivalent number in the new area code.[118] This limited the new numbers that became available. Not

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[113] *See* Toll Free Service Access Codes, Notice of Proposed Rulemaking, CC Docket No. 95-155, 10 F.C.C.R. 13,692, at para. 36-38 (1995); Burris v. S. Cent. Bell Tel. Co., 540 F. Supp. 905, 908 (S.D. Miss. 1982),

[114] *See* Number Portability Order, *supra* note 112.

[115] *See* Telephone Number Portability, Memorandum Opinion And Order And Further Notice Of Proposed Rulemaking, CC Docket No. 95-116 (Nov. 10, 2003).

[116] Toll-Free Numbers FAQ, *at* http://www.whoscalling.com/cmm_tollFree_FAQ.php

[117] Toll Free Service Access Codes, Second Report and Order and Further Notice of Proposed Rulemaking, CC Docket No. 95-155, F.C.C. No. 97-123 (1997).

[118] Diana Lock, *Toll-Free Vanity Telephone Numbers: Structuring a Trademark Registration and Dispute Settlement Regime*, 87 Calif. L. Rev. 371 (1999).

surprisingly, it created incentives for companies to claim that their numbers were valuable even if they really weren't. Although the new toll-free codes eventually launched, the process was fraught with difficulty.[119]

The next frontier of numbering is the convergence of telephone number with Internet identifiers. Addressing on the Internet works differently than on the phone network. Instead of a single telephone number, users have multiple identifiers for different purposes. A single user might have several email addresses, an instant messaging screen name, a website domain name, and a numeric Internet Protocol (IP) address dynamically assigned to his or her computer at each Internet log-in. Many of those addressing systems are privately managed, or based on compliance with open technical standards. The domain name system (DNS) however, is subject to a contentious governance mechanism.[120]

The DNS was originally managed by a private company under contract with the National Science Foundation, back in the days when the Internet was a non-profit research network.[121] Later, the US government established a quasi-private international governance organization called the Internet Corporation for Assigned Names and Numbers (ICANN).[122] ICANN oversees the difficult processes of creating new top-level domain names, resolving disputes over the proper ownership of individual domain names, ensuring the system's reliability, and addressing other policy issues that get dragged into the discussion.

The details of ICANN challenges and failings have been amply discussed elsewhere.[123] Yet perhaps ICANN's greatest challenge lies in the future. With the growth of VOIP, the phone network and the Internet are coming together. Today, VOIP providers can create their own private online addresses, but they cannot directly assign E.164 phone numbers. To allow calls to and from phone numbers, they must interconnect with a carrier that controls numbering resources, and translate their VOIP traffic onto or off the public switched telephone network. A protocol called

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[119] *See id.*

[120] IP addresses also require some governance. Because they are subject to greater technical constraints and do not raise the intellectual property and branding issues that domain names do, however, those governance issues have been much less significant than for domain names.

[121] *See* MILTON L. MUELLER, RULING THE ROOT (2002); Michael Froomkin, *Wrong Turn in Cyberspace: Using ICANN to Route Around the APA & the Constitution*, 50 DUKE L.J. 17 (2000); Jonathan Weinberg, *ICANN and the Problem of Legitimacy*, 50 DUKE L.J. 187 (2000).

[122] *See id.;* Susan P. Crawford, *The ICANN Experiment*, 12 CARDOZO J. INT'L & COMP. L. 409 (2004);

[123] *See* Mueller, *supra* note 121; Froomkin, *supra* note 121; Weinberg, *supra* note 121.

ENUM, for electronic numbering, promises to streamline that process. It would directly map between IP addresses and phone numbers.[124] And it wouldn't stop there. The ENUM system involves a database lookup every time an ENUM identifier is invoked.[125] That database lookup can retrieve other information beyond the simple voice/data translation. For example, a user's ENUM record could contain all that user's network identifiers, along with instructions about which of those identifiers to make available to others. The ENUM record could also be used for advanced call routing, allowing a user to specify parameters for which contact mechanism will be used under which circumstances.

All well and good. The problem with ENUM is that it raises all the challenges of domain names, and then some. Because ENUM bridges the gap between Internet addresses and phone numbers, it gives governments that want a greater role in Internet regulation a hook to become involved.[126] If ENUM is a successor to E.164 phone numbers, they argue, the governmental organizations and processes that hold sway for E.164 should apply to ENUM. Though the FCC has so far shied away from the ENUM debate, expressing an unwillingness to dive to far into the murky realm of Internet governance, it will inevitably be dragged in. That makes it all the more important for the FCC to think through its approach toward regulation of the connective layers.

V. How to Break the Ice

Both the legacy regulatory system and the legacy business models for the industry encouraged segregation and metering of traffic in ways that are increasingly unsustainable in a converged world. Not only does a layered framework help to diagnose these problems, it points the way toward solutions.[127] Below, I describe some of the impending conflicts

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[124] *See* Craig McTaggart, *The ENUM Protocol, Telecommunications Numbering, And Internet Governance*, 12 CARDOZO J. INT'L & COMP. L. 507 (2004); Anthony M. Rutkowski, The ENUM Golden Tree: The Quest For A Universal Communications Identifier, (2001) *available at* http://www.ngi.org/enum/pub/info rutkowski.pdf; Robert Cannon, ENUM: The Collision of Telephony and DNS Policy, *in* COMMUNICATIONS POLICY AND INFORMATION TECHNOLOGY (MIT Press 2002).

[125] The technical architecture is similar to that of domain names.

[126] *See*, McTaggart, *supra* note 124.

[127] For example, Solum and Chung derive a set of principles from the layered model, including disfavoring layer-violating regulation and targeting regulatory intervention to the appropriate layer. *See* Solum and Chung, *supra* note 39.

arising at the connective layers, and suggest how to extend the focus on these critical areas into affirmative policy reforms.

A. The Interface Layer

The interface layer is the first major phase transition, where content meets networks. In the argot of network engineers, content is fundamentally "data at rest:" information accessed at a single location. The user experience of listening to a CD playing locally on your computer, an MP3 music file that was downloaded over the Internet, and a streaming audio file that is delivered across the network as you listen to it, is basically the same. What you as the user care about is the music, not how it got there. How it gets there, however, is precisely the function of the network. The interface layer turns content into "data in motion," capable of being transmitted in real-time or asynchronously across the global network.

There are two major public policy issues arising today at the interface layer: privacy and digital access controls.

The "content" delivered through digital networks is not just commercial broadcast programming, such as Hollywood feature films and television shows. Converged digital networks are bidirectional, allowing users to send as well as receive content. Many people use the Internet to share digital photos, send email or instant messages, and operate Websites. Going forward, VOIP and video (both live webcam transmissions and pre-recorded video mail) will be an increasingly significant share of traffic.[128] Moreover, even when they aren't sending content of their own, users often send important personal information such as credit card numbers over the network. Privacy and security are thus important considerations. For the most part, such questions are in the purview of the Federal Trade Commission rather than the FCC.

Digital access control address the opposite problem: instead of how to secure the user's content through the network, they try to secure the content the user receives by preventing unauthorized use or redistribution. Digital access controls, and in particular digital rights management The

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[128] *See* Kevin Werbach, The Implications of Video P2P on Network Usage, in VIDEO PEER TO PEER (Columbia Institute for Tele-Information, forthcoming 2005). Already 35 percent of overall Internet traffic is estimated to be associated with BitTorrent, the most popular video peer-to-peer technology. *See See* Andrew Packer, The True Picture of Peer-to-Peer Filesharing, available at http://www.cachelogic.com/press/CacheLogic_Press_and_Analyst_Presentation_July2004.pdf, at 12.

FCC has waded into this mire with its broadcast flag proposal.[129] Under pressure from content owners, who argued that they wouldn't make digital programming available without assurances that receivers would be capable of enforcing DRM, the FCC adopted rules mandating that all devices capable of receiving digital television transmissions incorporate a so-called "broadcast flag."[130] Devices capable of receiving over-the-air digital television streams would have to incorporate technology that recognized and obeyed embedded right management instructions in the stream itself.

The broadcast flag is a classic interface layer issue. What sorts of legally-mandated restrictions should be interposed between content and the applications that process that content? Yet because the current structure of telecom law doesn't expressly incorporate a layered model, let alone one that recognizes the existence of connective layers, the Commission must cast in the dark for justifications. A number of organizations have filed a legal challenge arguing the Commission has no statutory authority to implement the broadcast flag.[131] As noted above, the FCC generally regulates broadcast transmitters, not receivers. It based the broadcast flag decision on its broad ancillary jurisdiction over "instrumentalities" related to communications, an exceedingly general provision.[132]

A legal and regulatory framework that surfaces the interface layer would not necessarily provide greater justification for the Commission's broadcast flag decision. On the contrary, a layered analysis could well provide a more direct route to the conclusion that such rules are a harmful roadblock to connectivity between two network layers, with spillover effects far beyond the intended problem. The value of the layered approach is that it focuses the debate on these issues, allowing policy-makers to weigh the proper pros and cons before moving forward. It also emphasizes the value of open connectivity to the network as a whole.

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[129] Digital Broadcast Content Protection, Report and Order and Further Notice of Proposed Rulemaking, MB Docket 02-230, (Nov. 4, 2003)

[130] *See id.;* Susan P. Crawford, *The Biology of the Broadcast Flag,* HASTINGS COMM. ENT. L.J. (2004).

[131] American Library Association et al v. Federal Communications Commission, DC. Circuit, NO. 04-1037 (TK case pending).

[132] American Library Association et al v. Federal Communications Commission, Brief for Respondents, http://scrawford.net/courses/04-1037%20(Amer.Lib.)%20FCC%20Brief.pdf.

B. The Logical Layer

The logical layer is the point of demarcation between software that talks to the network and software that talks to users. It is also the point that transforms streams of bits passing between machines into information moving to and from people. This is because the logical layer includes addressing and routing functions which associate traffic with individuals and their devices at the edges of the network. To the extent the logical layer has been regulated in the past, it is through the management of telephone numbers, as discussed below, and law enforcement access. Under Communications Assistance to Law Enforcement Act (CALEA), telephone companies are required to modify their digital networks to facilitate authorized wiretapping by law enforcement.[133] Recently, the FBI has expressed concern that VOIP calls might not be subject to CALEA, and has strongly urged the FCC to bring VOIP within the law's scope.[134] In August, the FCC tentatively concluded that "managed" VOIP and broadband access services are subject to CALEA obligations.[135]

Like the interface layer, the logical layer seems bound to play a greater role in communications policy in the future. Until recently, it has been difficult for any company to turn the logical layer into a point of control, because of the way the Internet works. Unlike the circuit-switched phone network, the Internet employs packet switching. Traffic is broken up into small chunks and reassembled at the receiving end.[136] There is no necessary distinction between one kind of traffic and another. Thus, a packet carrying a tiny snipped of a voice conversation looks essentially identical to a packet carrying a snippet of a Web page or music file. The opacity of Internet traffic can be accentuated through encryption, which hides the content of packets from anyone except the intended recipient. Furthermore, applications can make traffic identification more difficult by shifting port numbers and other technical parameters.[137] This last technique is especially common for peer-to-peer file-sharing applications, which seek to avoid interference by both content owners fighting copyright violations and service providers facing huge bandwidth utilization. Even

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[133] 47 U.S.C. § 1001 et seq.

[134] *See* Department of Justice, Federal Bureau of Investigation, and Drug Enforcement Administration, Joint Petition for Expedited Rulemaking, RM-10865, filed March 10, 2004.

[135] See Communications Assistance for Law Enforcement Act and Broadband Access and Services, Notice Of Proposed Rulemaking And Declaratory Ruling, RM-10865 (Aug. 9, 2004).

[136] *See* Digital Tornado, *supra* note 2.

[137] *See* Implications of Video Peer to Peer, *supra* note 128.

when traffic can be identified, the sheer speed of transmissions across network backbones makes it technically challenging to classify traffic flows while they are actually moving across the network.

A new technology called deep packet inspection promises to overcome some of these limitations.[138] Deep packet inspection uses specialized high-speed hardware and software that can identify packets in real-time. A service provider could use deep packet inspection to distinguish peer-to-peer traffic, or even just traffic from a single peer-to-peer file-sharing application, and either block it or reduce its available bandwidth. Without deep packet inspection, service providers and others could only resort to crude application-level techniques, such as cutting off all streaming video clips using standard formats after a certain time.[139] Deep packet inspection allows true logical-layer control based on ownership of the physical layer.

Service providers may deploy deep packet inspection gear for several reasons.[140] With peer-to-peer applications representing more than half of the total traffic on the Internet,[141] broadband service providers have incentives to limit those applications' bandwidth utilization. Separately, the FCC's CALEA proposal would require network owners to facilitate wiretapping of VOIP calls. Deep packet inspection could make that easier to accomplish, by isolating VOIP traffic flows. Cisco recently paid $200 million to acquire P-Cube, a deep packet inspection startup, indicating the level of interest in the potential market for such technology.[142]

CALEA implementation and traffic peer-to-peer shaping are relatively innocuous uses of deep packet inspection, at least from a competition policy standpoint. Once these devices are installed in the network, however, they can be employed for entirely different purposes. Segmenting applications at the logical layer could allow broadband providers either block or degrade independent application and content providers. In particular, deep packet inspection could be employed against third-part VOIP providers.[143] Network owners have incentives to favor their own VOIP offerings, which they can promote as offering higher

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[138] *See id.*

[139] This is in fact what early cable broadband provider @Home did. *See* Lemley & Lessig, *supra* note 66.

[140] *See* Implications of Video Peer to Peer, *supra* note 128.

[141] *See* CacheLogic presentation, *supra* note 128.

[142] *See* Reuters, Cisco to Buy P-Cube for About $200 Million, August 23, 2004.

[143] *See* IP-Enabled Services, WC Docket No. 04-36, Ex Parte Comments of Nuvio.

quality than competitors'.[144] An indication of the attitude operators harbor toward independent VOIP providers was suggested in mid-2004, when a P-Cube executive told *Barron's* that VOIP services "raped" cable broadband networks.[145]

C. By the Numbers

In addition to policing the connective layers, the FCC could use numbers as an affirmative basis for a new policy approaches. A number-based approach would be particularly valuable for addressing the thorny challenge of universal service. As noted at the outset, the perceived need to preserve universal service subsidy flows is a significant factor propping up the anachronistic geographic- and minutes- based structure of the telecom industry. Moreover, so long as new forms of competition and innovation are seen as a threat to the stability of universal service subsidies, there will be calls to regulate those innovations first and ask questions later.[146]

One basic problem is that universal service contribution rates are currently derived from minutes of use. This metric makes no sense in an Internet environment, because the Internet does not tie up specific resources for defined periods of time. Moreover, a minutes-based system either requires all VOIP traffic to be tracked and metered in order to facilitate collection of universal service subsidies, or it faces a downward spiral as traffic leas out into VOIP networks. Already, because access lines are falling, universal service surcharges have increased substantially.[147]

An alternative approach is to impose universal service contributions not on networks, but on numbers. When a user signs up for a phone number, or to renew an existing number, he or she would pay an annual fee, which would be used to fund subsidy programs for high-cost areas. The arrangement would resemble the current process of obtaining an

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[144] *See* Tim Wu and Lawrence Lessig, Ex Parte Submission in CS Docket No. 02-52, *available at http://faculty.virginia.edu/timwu/wu_lessig_fcc.pdf.*

[145] Eric J. Savitz, "Talk Gets Cheap: Internet telephony is bad news for the Bells, but maybe great news for the cable guys," Barron's, May 24, 2004.

[146] *See* Jonathan Weinberg, *The Internet and "Telecommunications Services," Universal Service Mechanisms, Access Charges, and Other Flotsam of the Regulatory System*, 16 YALE J. ON REG. 211 (1999). A good example of this dynamic was the effort by Senator Ted Stevens, then chairman of the Senate Appropriations Committee, to pressure the FCC to regulate VOIP, out of concern about universal service subsidies. *See* Layered Model, *supra* note 6.

[147] *See* Donny Jackson, "Universal Concerns," *Telephony*, Dec. 13, 2004.

Internet domain name. Users would gain limited property rights in the numbers they use, but would have to pay to maintain their rights.

Such an approach would provide a stable foundation for universal service funding, because it would make no distinction between circuit-switched and VOIP calls. Any connection involving a phone number would pay in. On the other hand, connections to private services using their own identifiers would not be subject to universal service contribution obligations. Few users will give up the ability to receive calls from the two billion or so E.164 phone number users, which dwarfs any private VOIP or IM service.

If, over time, users start to migrate away from phone numbers, the FCC has two options. It can bring the largest addressing systems into the universal service funding pool. Or, it can decide that, with phone service now decisively changed from a service tied to the physical layer into an application for broadband connections, the justification for physical-layer subsidy flows has been eroded. By drastically reducing the cost of voice communication, VOIP may also reduce the need for subsidies to keep prices in rural areas at affordable levels. Perhaps there will remain a need to subsidize local broadband access in rural areas. Any such subsidy program, however, can and should be distinguished from an effort to ensure universal deployment of basic telephone connections.

Beyond universal service, numbers could be used a dividing line for other regulatory obligations. Rather than engage in a metaphysical debate about the nature of “telecommunications” and “information services,” the FCC could use a bright line test. Either a service incorporates E.164 phone numbers, or it doesn’t. By raising the profile of numbering in its regulatory calculus, furthermore, the FCC would be in a better position to address the significant logical-layer questions that are likely to come before it in the near future.

VI. Conclusion

Whichever direction telecom policy goes in the years ahead, the status quo is not a satisfactory option. The industry and its underlying technology have changed too dramatically to function under a regulatory paradigm that traces its history directly back to the 1800s. Following the spectacular boom and equally spectacular crash between 1998 and 2002, the telecom world is continuing to gradually warm up. New technologies such as VOIP and peer-to-peer video are changing the way networks are used, and new competitive lines are being drawn among the providers of those networks. Through this process, the old silo approach to regulation is melting away.

The layered model provides a fresh way of thinking about telecom policy. It is perhaps most useful in framing questions, helping policymakers identify hidden tension points and giving them a better vocabulary to craft solutions. As telecom comes to a boil, the challenge is to use the layered model as a framework for a new policy agenda. That agenda should start with the interface and logical layers, whose significance will only continue to grow.