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***69** REFINEMENTS OF A LAYERED MODEL FOR TELECOMMUNICATIONS POLICY

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ABSTRACT

Inconsistencies within the various areas of telecommunications policy make for rich debate. For example, cable Internet service providers are not obligated to provide competing service providers with wholesale pricing for access to customers, while incumbent local exchange providers (specifically regional Bell operating companies) must provide such Internet access. Several authors have proposed models to resolve these inconsistencies; however, efforts to build a better policy mouse-trap continue to elude interested parties. While some claim that the existing title-based approach is not broken (and therefore should not be changed), others argue that the inconsistencies will lead to market distortions and slower deployment of broadband services.

One proposed telecommunications policy model is based on a layered design similar to that used in the development of technical communications protocols. The consistency and modularity of such a policy approach may be a workable alternative to the current title-based policy; however, a layered model in and of itself is insufficient. A layered model solution must reflect the reality of network design, market power, and business arrangements, and, to be viable, it requires a transition policy to get there from the existing policy regime. Policy makers must understand the diversity of existing access technology (e.g., cable networks versus common carrier wireline networks), the disparity within industry segments (e.g., ILEC vs. CLEC use of last mile) and the strong influence of present policy on these various segments before implementing a transition to new policy. In this paper, we propose a framework to serve as the basis for a unified ***70** layered policy model. We also discuss the difficulty of transitioning from the legacy service and architecture specific model to a generally applied layered model. Our model focuses on the interconnection relationships among the various players.

INTRODUCTION

Current policy applies regulatory conditions based on the type of infrastructure on which a telecommunications service is offered. For example, under the Telecommunications Act of 1996 (1996 Act), [FN1] Title VI regulates cable networks [FN2] and Title II regulates wireline telephone networks as common carriers. [FN3] This model results in inconsistent treatment for providers of the same service if they use different networks. These inconsistencies have motivated several authors to suggest alternative regulatory models that would better serve public policy. [FN4] They are concerned that policy inconsistencies will lead to problems such as market distortions, slower deployment of broadband services, discriminatory bundling, and discriminatory content decisions. Some authors argue for a regulatory model based on the layered protocol concept. [FN5] Others focus on market power, rather than service provisioning, as an appropriate threshold for invoking regulatory obligations. [FN6] Still other authors argue that the existing ***71** title-based approach is not broken, and therefore should not be changed. [FN7]

This paper focuses on the viability of the layered regulatory model approach. While, at first, a layered approach seems well founded in and of itself (i.e., based on well understood engineering principles), it can be plagued by numerous shortcomings. Many of the problems have to do with defining the details of the model and the concepts used to describe this model. Concepts like openness and interface must be well defined before implementing a viable model; otherwise failures might arise in the nascent competitive communications landscape. Such failures could lead to industry consolidation, which could derail the market-driven competitive environment envisioned in the Telecommunications Act of 1996. [FN8] Further, it may derail the inter-modal competition that appears to be driving deployment in the present marketplace. [FN9] While a better understanding of the details is necessary, one can get lost in the details as well. Over-specification could inadvertently stall the process or be used as a tool to forestall change.

This paper concludes that a consistently applied layered model is indeed a desirable long-term solution, and addresses the concomitant need to define a transition strategy. The strategy will involve shifting policy from the present complex and diverse structure of title-based regulation toward that of a simplified and unified policy. A successful long-term model must recognize the importance of market power and it must maintain a high degree of technical neutrality.

This paper investigates the groundwork necessary for revamping telecommunications policy and proposes a framework for a solution. It focuses on the complexities and interdependencies that will affect the transition to a layered policy model, beginning, in Section I, by setting forth the existing regulatory structure and its shortfalls. Section II explores the issues and competing goals that legislators and regulators will have to consider prior to creating an effective new regulatory model. Specifically, it discusses the shortcomings of some proposed layered models, the difficulty in defining the layers and interfaces required ***72** of such a model, and the problems that might arise by using vague (or misinterpreted) terms, such as openness, layers, and interfaces. This section also proposes a conceptual framework for understanding interconnection relationships as the basis for a unified layered policy model, and discusses the difficulty of transitioning from the legacy service and architecture specific model to a generally applied layered model.

I. THE ISSUES

The existing policy is one of service/infrastructure specific regulation. The model applies regulatory conditions based on the type of infrastructure on which the service is offered. For example, the Communications Act regulates cable networks under Title VI and wire-lined telephone under the Title II.

The 1996 Act directed the Federal Communications Commission (FCC) to shift to a less regulatory environment. Part of this shift included moving to a market approach rather than relying on the burdensome common carrier policy now in place. Before market mechanisms can operate, however, there must be a sufficiently competitive market environment. Legislators and regulators hoped that alternative providers would be available in adequate numbers to ensure reasonable levels of competition. The government continues to invest significant regulatory effort toward opening the public switched telephone network (PSTN) to competition. [FN10] Time will tell whether FCC efforts will improve local telephone competition.

In spite of its high aspirations, the 1996 Act failed to provide significant reform or to significantly increase competition in telecommunications access services. This paper argues that this is because the law continues to address competition along the traditional lines of communications, with different rules applying to each physical infrastructure type. The 1996 Act provides little guidance for accommodating evolving telecommunications infrastructures that are blurring the boundaries between existing industries. One cause of this blurring is that the information services sector of the marketplace is not simply a layer of services; ***73** it is becoming a form of telecommunications itself. [FN11] Although national Internet Protocol (IP) backbone service (or IP transport service [FN12]) is considered an information service from a regulatory perspective, one may argue that an Internet service is "telecommunications," i.e., the "transmission, between or among points specified by the user, of information of the user's choosing, without change in the form or content of the information as sent and received." [FN13]

Some argue for classifying IP backbone service as a telecommunications service in order to level the playing field with respect to regulatory benefits and burdens on similar transmission services. It would not be a simple task, however, to reclassify IP backbone service as a telecommunications service. The rationale behind many of the interconnection obligations associated with the telecommunications classification is tied to the technology, and would not be directly applicable to IP transport services. [FN14] In addition to the detailed (and therefore legally-intensive) interpretations that would be required to reclassify IP transport as a telecommunications service, federal policy makers may also be hesitant because this action would expose reclassified national IP backbone service providers to state obligations. States have the authority to regulate telecommunications services to the extent that the FCC does not assert jurisdiction under the Communications Act. [FN15]

Policy makers have been hesitant to impose additional regulation on national IP backbone service providers, fearing that premature or misguided regulation might frustrate the rapid rate of technological innovation. [FN16] In addition, forcing the Internet into the current categorized regulatory structure leads to ***74** complex and inconsistent solutions. This is not to say that such decision-making has not been in the public's best interest, but rather that it generates contrived justifications for decisions that are then difficult to defend in the courts.

Another shortcoming of the 1996 Act is that it may not provide sufficient direction to industry, local and state regulators or the public. The parties involved in regulating and providing telecommunications would benefit from direction set forth in explicit guidelines. Such a mechanism might include title (e.g., Title II, III and VI) independent guidelines for the interconnection of packet networks. In addition, providing a mechanism for cooperation may be better for promoting goals than the current scheme of penalizing industry participants for violating policies (poorly articulated policies at that). Whatever role policy makers assume, it is essential that this involvement takes a forward-looking perspective and departs from the existing title specific regulation.

It is important to note that providing sufficient policy direction need not imply regulation; policy and regulation are not equivalent. Regulation is but one of several mechanisms used to implement telecommunications policy. Without developing a coherent telecommunications policy and plan to ensure the achievement of its goals, it is no more sensible to proclaim regulation than it is to proclaim deregulation. [FN17]

The Computer Inquires established a useful precedent for justifying a transport layer separate from those that ride on it. [FN18] However, neither the Computer Inquiries nor the 1996 Act truly set the stage for a unified layered model. While one could argue that things like the Open Network Architecture and aspects of the 1996 Act are in the spirit of a layered model, they fall short of providing a complete framework. Even with the separation of ***75** basic (telecommunications) from enhanced (information) services, there is nothing to provide the proper guidance on emerging services or the interconnection issues that will arise. Further, we contend that this past regulatory framework has been misapplied, which has led to some of the discrepancies we see today.

II. TOWARD A SOLUTION

A. Before the Debate Begins

A major difficulty with moving to any new policy model is in understanding the depth and scope of the problem. In other words, "the devil is in the details." This section addresses some of these details. It does not purport to ask all of the relevant questions; it only tries to demonstrate the complexity of the task. It begins by considering the definition of the term openness. Then it considers openness issues in the context of layers and interfaces. Lastly, it considers the crux of the problem: the transition from the existing service/infrastructure specific regulation to that of a layered model.

The intention is to avoid getting mired in the details, and to avoid defining a solution so stringent that it is unworkable. Rather, we attempt to define the concept of openness in such a way as to provide a roadmap for policy makers and policy thinkers.

1. Defining Openness

The term "openness" is commonly used by policy makers and others without considering its meaning or even the consequence of its use. Openness can be defined at so many levels and with such varying degrees that the term often causes confusion and disagreement. Therefore, without further definition and specification, the term openness is arbitrary and really a matter of perspective.

There are many aspects of telecommunications that might be considered within the definition of openness. These include:

• Open standards [FN19]
• Open architectures [FN20]
• Open interconnection [FN21]
***76** • Open interoperability [FN22]
• Open directories [FN23]
• Open application [FN24]
• Open code [FN25]
• Open content [FN26]

Each of the examples above could be further broken down into considerations such as the degree of openness and the availability of the element and the pricing of that element. Policy makers who seek openness need to specify the kind of openness they seek. The preferred type of openness depends on the desired policy goals. Without adequate specificity, policy makers run the risk of derailing the desired effects of their policy changes. Later subsections will elaborate on these points. In defining what to open, policy makers should take care to consider how this change will impact the competitive nature of the particular market.

With respect to traditional telecommunications systems, policy makers have long wrestled with the issue of what elements of the communications system to open and how to accomplish this. [FN27] One recent example is the opening of the incumbent local exchange carriers' (ILECs') local telephone networks to competitive local exchange carriers (CLECs) as permitted by Section 271 of the 1996 Act. [FN28] ILECs may have an incentive to allow local competition because, in order for ILECs to gain entry into the long distance market, they must prove that they are providing specific competitive opportunities for CLECs. [FN29] Much of this proof has boiled down to the availability of interfaces required for CLECs to make use of ILECs' networks. While some CLECs have been successful at gaining access, the process of opening local markets has been long and protracted. [FN30] It might be that ***77** the proper (or sufficient) incentives were not in place to ensure negotiation of competitive access.

The predominant modern example of a successful open telecommunications system is the Internet. [FN31] Many scholars argue that the success of the Internet is, in large part, due to its open design, and that the open design allowed the Internet to grow in so many directions so quickly. The Internet remains open because no single entity controls it. There are aspects of the Internet that are less open than others, such as certain access networks, certain content, and the interconnection of certain IP backbone providers' networks. Control over the resource is the pivotal issue in each of these areas. If a party has a proprietary interest in the network, for example, it is unlikely that the network will be open to all users. In general, however, the Internet remains open to new players, new services, new access schemes and other new opportunities.

It is worth mentioning that it is all too easy to comprehend the openness of the Internet, but it is difficult to map this openness onto business and architectural models in the current regulatory model. This leads to the solution proposed in this paper; that implementation of open systems requires an entirely new, layered framework.

2. Concerns About Layered Models

a) Defining the Layers

As described briefly above, and more fully later, a layered model is often the structural basis proposed for substantial regulatory reform. To understand the basic layered model theory, it is necessary to understand the concept of a protocol. A protocol defines a language of rules and conventions for communications between entities. A series of layers define the communications protocols, which together provide the means for communications on networks. Layers allow for modularity of design, which in turn allows functions to be divided into well-defined and manageable tasks. The idea of a layered model for protocol design is not something unique to the Internet protocols. [FN32] What is arguably ***78** unique to the Internet is that most protocols are developed through an open, market-driven standards process.

The model proposed by Werbach specifies four layers: physical, logical, application and content. [FN33] The model proposed by Lessig contains three layers: the physical, the code and the application. [FN34] Other models have specified a similar layering. While these proposed structures create boundaries, they may inadvertently combine aspects of communication that technology and business divide. Some models combine the various access and transport networks into a single layer (the physical), something that does not line up well with existing network architectures, business models or regulatory models. [FN35] Further, combining the different access methods, which differ in terms of technology, ownership and business, could inadvertently lead to technology lock-in.

Another concern is the use of the terms "logical" or "code" layers. These layers are defined in terms of the protocols and the instantiation of software. In the case of the "logical" layer, Werbach describes this as the protocol or a standards layer, which seems ill-conceived in that all of these layers involve protocols or standards. The "code" layer is described in terms of software, but the software is simply the tool used to invoke the requirements of the various layers. It seems that "code" should not be defined as a layer, rather as a principle - as in "open source code." In this way the virtues of open (or closed) source code could be considered without tying it to the regulation.

While in the long run it may be appropriate to create a layer that serves as an abstraction of the IP service (the "logical" or the "code" layer discussed above), this approach also creates problems. It is likely that the owner of the physical and the logical network will be one. If the logical layer is lightly regulated, this owner may be able to take advantage of this light regulation together with control of the physical network to thwart competition. It is difficult to apply a unifying policy model to the existing networks, services and content because one may be forced to assume (or abstract) away so many technological, policy and economic considerations that it is impossible to create policy that aligns with economic and business reality. A workable solution ***79** must take care in defining the layers in a manner that aligns with these needs.

We believe that a better model would subdivide the physical layer in terms of access and backbone, as well as in terms of who provides the service. As described later, one could differentiate the physical players on a basis of market power, not on the basis of network type. Applications will depend on the services of the physical layers. [FN36]

b) Regulating Layers

Once defined, the layers will require regulatory constraints. These decisions will likely be a coordinated effort of government, industry and other interested parties. With this close cooperation between government and industry, the FCC might consider how best to develop this relationship through measures such as Section 256 of the Communications Act. [FN37] This Section gives the FCC authority to participate in industry standards-setting organizations for development of interconnectivity standards. [FN38] If we move toward a layered regulatory model, policy makers may need to rely more on groups typically outside of the regulatory process (such as standards bodies) to assist in this effort. Even within a layer, the government will need to rely on various standards bodies. Policy makers should seek assistance from the Institute of Electrical and Electronics Engineers committees for developing network standards (e.g., the IEEE 802 Committee) [FN39] and CableLabs, a non-profit research and development consortium of cable television system operators. [FN40] These bodies created many of the access standards on which IP-based services ride. [FN41]

c) Ensuring Competition in a Layer

Control of any layer could create problems. Serious problems arise when a dominant provider can assert their control of multiple layers or combine their layers with those of other ***80** providers in an exclusionary and anticompetitive manner. For example, a party in control of the physical layer may technically open it to competitors, but charge so much for access to the network that competitors cannot afford to compete. While it may not be popular to embrace regulatory pricing models, [FN42] they may be a necessity. Without competition or regulation, it is difficult to believe that a dominant player would allow their profits to erode by allowing a competitor low cost access. These players are trying to create value for their stockholders, and are therefore motivated to make it harder for competitors to compete.

In addition to price regulation, two other regulatory methods may encourage competition at the physical level. First, business incentives can encourage open access at other levels. For example, access networks (be it telecommunications, cable or other) could be separate from the services riding over them (voice, data, video), which could be separate from the content. [FN43] This would prevent the physical network providers from exclusively carrying their own services and content, and eliminate discrimination against other service and content providers. Second, encouraging inter-modal competition by permitting "closed" physical facilities might invigorate deployment and technological progress. One could argue that it is the "closed" aspect of cable that is driving broadband deployment and emergent broadband services. In other words, let the big players fight it out. One might argue that even though (initially) the physical network owners will have monopolies, they will have the incentive to use their networks to provide new, overlapping services. [FN44] Note, that the authors are not necessarily advocating this closed model.

One extension of the layered model of policy is the layered model of ownership and separation between the various business segments. Preventing owners from exercising control in more ***81** than one layer avoids the problems of vertical control. There are many examples of this policy, including the divesture of the Bell System and the LoopCo model. [FN45] In the past, such divisions have included everything from complete divesture of services to separate accounting mechanisms. The most relevant to this discussion would be the divestiture of the ILECs local loop. Faulhaber has shown that such a divestiture would have created a better model for local competition than the unbundled model imposed by the 96 Act. [FN46] This paper does not delve into the pros and cons of separating ownership of physical layers, but suffice it to say this policy would be difficult to carry out.

While separating layer ownership resolves a number of competitive concerns, it also creates other policy concerns. Some would argue that such separation would discourage investment and lead to further delays in the roll out of broadband services. In addition, the incumbent companies have spent a great deal of money and time trying to combine various layers, and are not likely to accept separation of layer ownership without a fight. A number of recent mergers have been based on the desire to combine content and conduit. [FN47] The approval of these mergers might suggest that such separation is not of interest to the policy makers. [FN48]

3. Concerns About Interfaces

a) Defining Interfaces

Implementation of a layered model requires an understanding and definition of the interfaces between the technical layers. This is no trivial matter. Not only is it difficult to define an interface, but the interface requirements will differ as one traverses the stack of layers. In other words, the interface requirements that exist between lower layers will not resemble ***82** the interface requirements that might exist between higher layers. Further, the definitions of interfaces must be able to stand the test of time as technology, services and business models change.

Depending on the layer, an interface can vary significantly. An interface might require technical specifications or it might require a business contract defining the availability of content (e.g., digital rights management). When computer scientists or electrical engineers define an interface, the outcome is highly dependent on the layer of concern -- a physical interface will include such specifications as electrical, mechanical and functional characteristics; whereas a logical interface may require a definition of addresses, ports or other information. An interface between the application and the content would likely take the form of a contract specifying content use.

As we move up a layered policy stack (from physical to content layer), we find ourselves moving from technical-oriented to more business-oriented specifications. This abstraction is expected, as the interface between the content layer and the application layer would have less technical requirements but would be dominated by policy; whereas the interface between the access network and the inter-network would require more technical specification.

One significant and difficult issue in defining interfaces is deciding how much detail to include in interface regulation. While an actual technical specification will be highly detailed, a policy might be more general in order to ensure that the proper goals are promoted while the policy withstands technological progress. Policy references to standards organizations' specifications could provide the technical level of specification, while contract law could provide the legal obligations. Thus, technical and legal specifications could change with technical and legal advances, without having to rewrite the policy itself. We believe that policy makers should tread lightly in this area, and act only as warranted by policy.

b) The Effect of Technology on Defining Interfaces

The sub-classification of layers within the physical network, suggested above, may be necessary to make a layered model operational with respect to interfaces. Some of the variation that exists among the lower layers of the various access technologies relates to the media (e.g., over-the-air versus cable versus copper pair), other variation relates to the data link layer required to make use of the physical media (e.g., share radio spectrum, a ***83** shared wire, a dedicated wire). These technologies differ in ways that make it difficult to compare them. [FN49]

The method of providing real-time services varies with the physical implementation of the underlying infrastructure. Real-time services demand a specific, or at a least guaranteed-minimum, quality of service (QoS). The technology (e.g., QoS, traffic engineering) used to provide this quality of service resides on different layers. This technological straddling of the layers suggests some of the difficulties that policy makers will have in drawing clear regulatory boundaries between technological layers.

Voice will remain the most critical service/application. Since the majority of voice customers will remain on the circuit-switched network for some time, it is important that interconnection to the PSTN is available to all consumers. Therefore, it is not enough to know how to interconnect (as defined by the appropriate interfaces), but one must also be able to obtain the physical interconnection with the PSTN.

A very important point to consider is that no matter how the layers are divided, if two players are going to interconnect their networks, this connection comes down to a physical (or a logical) interconnection. This point cannot be over-emphasized. Thus, even if the layers are described and divided in some ingenious manner, the physical interconnection must be created. Interconnection simply cannot be ignored.

c) Interface Availability

The issue of interface availability is complex and highly dependent on who controls the resources. If a monopoly (or duopoly) provider exists, then it is unlikely that we can move toward a layered model without significant regulatory structures in place, be that legacy or new regulation.

4. Clarifying and Unifying the Policy

a) Clarifying the Goals

Telecommunications policy is largely based on public policy goals. Legislators and regulators contemplate a certain set of goals (either implicitly or explicitly) and they create telecommunications law according to the methods deemed most appropriate ***84** to achieve these goals. In order to interpret the implications of the emerging networks for telecommunications policy, it is important to first understand the goals upon which the policies are based. Depending on a stakeholder's perspective, the relative importance of policy goals will vary. Public policy goals may include: ubiquity of service availability, free flow of information, non-discrimination in the carriage of information, cost-based prices (i.e., no monopoly rents), efficient use of public goods (e.g., over-the-air spectrum, right-of-way), rapid deployment of advanced services, and appropriate investment signals. Stakeholders include policy makers (such as Congress, the FCC and the state Public Utility Commissions), industry players, academics, consumer groups, the public, etc.

Once the goals are resolved, the government traditionally takes one of three broad approaches to achieve telecommunications policy goals; they are as follows:

• Setting market rules to achieve economic goals. For example: 1) managing accumulation of market power via merger reviews and antitrust proceedings; 2) requiring resale and unbundling to reduce the barriers to entry for new competitors; 3) requiring that telecommunications carriers interconnect with all players to reduce barriers to entry; 4) regulation of prices when market forces are absent due to perceived natural monopolies; and 5) ensuring separation to prevent a monopoly from subsidizing a competitive business segment with excess profits generated from a monopoly business segment.

• Supporting societal goals. For example: 1) requiring that all telecommunications carriers pay into the USF to subsidize communications access for selected groups of U.S. residents and organizations; 2) requiring that telecommunications carriers not discriminate; and 3) fostering interconnection.

• Investment in public initiatives. For example, by funding the NSFnet backbone network (1985 to 1995), the government directly invested in public initiatives; i.e., the education research infrastructure. This investment also (indirectly) encouraged innovation by providing a network infrastructure upon which new services could be developed, tested and deployed.

b) Defining a Unified Policy

Creation of a sustainable and unified theory for telecommunications policy will require agreement on a basic set of goals. The intent of telecommunications reform should be to create an environment that promotes general policy goals. A new set of laws and regulations must primarily promote ubiquity, nondiscrimination ***85** and rapid deployment of advanced services. Unfortunately, these goals often conflict with one another; therefore, they will require efforts to achieve balance. For example, consider the dilemma created by the 1996 Act, which requires the FCC to ensure that advanced services are deployed rapidly and to all Americans, [FN50] posing market efficiencies (rapid deployment) against incompatible societal goals (universal service). While taking advantage of market forces to ensure timely deployment, regulations must simultaneously provide constraint to ensure competition and to spread deployment widely.

Introduction of a layered policy model should support the market principles sought after in the 1996 Act. FCC policy should ensure that interconnection is not destroyed or disabled by distortions in the market. Transitioning to a market driven model is not a simple matter; it involves much more than dismissing the current regulatory model, and then blindly relying on the market. A number of concerns surround interconnection in a market-based approach. The most prominent concern is the dominant control of an essential service. This is especially true now that the FCC has placed great emphasis on reactive measures (such as enforcement of rules, contract law and antitrust actions), and depends less on traditional, proactive (i.e., regulatory) measures. This may result in a slow-to-respond process that can lead to market distortions. The trick is to encourage interconnection while not imposing burdensome regulations on network providers.

To begin a transition to a market-based approach to telecommunications policy, policy makers should consider their decision-making process in a more comprehensive cross-title manner. This is indeed what occurred in the notice of inquiry (NOI) on high-speed access mentioned previously, where the inquiry considered multiple forms of high speed access, each of which regulated under a different title. Regulators should move away from complex and overly defined regulatory solutions and toward more basic solutions based on key policy goals. While the structure of the Communications Act is flawed, its policy goals, explicit or not, should remain the ultimate basis for decision-making. The main advantage of a layered policy approach is that it creates a level playing field for regulated entities and services, avoiding inconsistencies. While this may appear desirable, it is important to recognize that the present regulatory structure allows policy makers to make decisions separately with respect to ***86** each market (telecommunications, cable, wireless) without concern for what this might mean for the others. [FN51] If the policy makers had to create policy that spanned all technologies, it might create an intractable problem due to the huge number of variables to consider. One might say that the solution to this problem is to consider a subset of the layers, each containing a smaller set of variables, and indeed this paper argues that this is the long- term solution.

B. Proposed Solution

Some analysts argue that ensuring the continued openness of the Internet is the best way to ultimately avoid the problems of the current regulatory approach. [FN52] The Internet may take over as the common platform for all telecommunications, in which case its open character will be pervasive. This requires regulations that protect the open aspects of the Internet. This openness could erode if dominant players exert pressure in the access networks or backbone networks, or within the operating system software, services or content. While policy makers should create policy that protects the "openness" of the Internet, they should take care not to create policy that is specific to the technology. This paper proposes that the best course for communications regulation is continued vigilance in maintaining the Internet's openness. This does not necessarily translate to heavy-handed or haphazard regulation; it requires careful consideration of regulatory proposals.

1. Framework for a Solution

As indicated earlier, defining openness will require a significant understanding of the technical, policy and pricing requirements. To define openness, one must consider the aspects of the desired policy layer or interface and what is required to provide a service or function. This is no easy task, especially when complicated by conflicting policy goals. As previously indicated, not only should a new regulatory model provide more relevant delineation within the layers, it should also take into account other technology, business and policy issues. These issues drive the concept to a more dimensional layer of stacks, a model which assists in the understanding of the differences of access networks and transport networks.

***87** This paper does not intend to create new telecommunications policy; rather, it provides a framework for policy makers to apply when considering new regulation. Framing the problems in a logical and consistent manner is a necessary precursor to contemplating the details of the policy.

As previously noted, several authors suggest a regulatory model based on the open concepts of the TCP/IP protocol suite. While it is true that the IP protocol (and the associated TCP/IP protocol suite) serves as a common and open protocol for many communications services, these specifications deal only with the technical characteristics of the protocol and not the business or policy characteristics. It is also worth considering the diversity of access protocol layers beneath TCP/IP; e.g., Ethernet, 802.11, ATM, GigE. This latter distinction is important to consider as some of the most contentious policy battles revolve around the access networks. [FN53]

To define the layers correctly, one must consider the services provided and the structure of the network. In previous unpublished work, [FN54] the authors proposed a conceptual framework based on service and network structure. This framework should allow policy makers to systematically evaluate interconnection relationships between providers. The layers distinguish between types of physical services (e.g., access, transport), application services (e.g., directories, caching, electronic mail), content services, and Legacy Telecommunications Services (i.e. traditional PSTN telephony). These categories are further described below:

- Physical services: Providers of 1) Access and 2) Transport Services; including both best-effort and QoS services. These may include network operators, network access point (NAP) operators and GigaPOPs. [FN55]
- Applications services: Providers of application services that rely on underlying access and transport services can be further subdivided into three subcategories: 1) directory service providers (e.g., DNS); 2) intermediate or middle service providers (e.g., multicasting and caching); and 3) end user service providers (e.g., electronic mail, Web hosting, Search engines). One could argue that these three subcategories are distinct and should be treated as ***88** such, but this broad categorization is sufficient for this context. The point is to distinguish between the provision of a data delivery service and the entities that use the data delivery service. The specific interconnection differences that arise for each of these three subcategories are beyond the scope of this paper.

• Content: Content providers that rely on underlying transport, access, application-directory, and application-intermediate services. Examples of content include video, music, and telephony services.
• Legacy telecommunications services: Telecommunications service providers as generally defined in the Communications Act.

One could also argue that software developers and consumers are also crucial to the deployment and use of the infrastructure, and should therefore be included in the framework. Software developers are not, however, generally subject to telecommunications policy today. [FN56] Services and service providers tend to be of concern, rather than those parties that actually develop the services on behalf of the service providers. Consumer benefits and costs are central motivating factors in telecommunications policy, but since they are not directly associated with interconnection of provider networks, they are also beyond the scope of this interconnection analysis. This paper refers to the heterogeneous group of providers that provide the emerging IP infrastructure (i.e., Access providers, Transport providers, Applications service providers, and Content providers) as Internet service providers. As mentioned earlier, some view the separation of the IP service from the physical transport as a beneficial distinction; we do not make that distinction in this model.

This layered stack provides a framework for systematic evaluation of the interconnection relationships between the layers. From the perspective of interconnection policy, the most important provider relationships are:

• A - Access Provider to Access Provider
• B - Access Provider to Transport Provider
• C - Transport Provider to Transport Provider
• D - Transport Provider to Application Service Provider
• E - Application Service Provider to Application Service Provider
***89** • F - Application Service Provider to Content Service Provider
• G -- Internet Service Providers to Telecommunications Service Provider

Relationships A through F are depicted in Figure 1.

Figure 1-Relationships between Infrastructure Service Providers

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Figure 1 shows a conceptual (simplified) protocol stack that providers of IP infrastructure might employ. From a telecommunications policy perspective -- and the perspective of this paper in particular -- these layers are of primary interest. For example, a transport provider will use applications on their network, but since they offer the transport service to the public for a fee, the transport is the service of interest. Similarly, a caching provider will employ an Intranet to interconnect their caches, and to connect their caches to the public transport network. Since they offer the caching service to the public for a fee, caching is of interest, not their private Intranet.

Figure 2 depicts relationship G, between Internet Service Providers and Telecommunications Service Providers. The diagonal layering implies that PSTN voice and PSTN transport services are more tightly coupled than are the modular layers in the emerging IP infrastructure.

In Figure 2, services that would be considered an application service in an IP context (e.g., SS7/IN and directory services) are in the upper diagonal, and those services that would be considered a transport service are in the lower diagonal. Both are considered telecommunications services in legacy PSTN regulation.

Figure 3 depicts an abstracted interconnection between the emerging IP infrastructure and the legacy PSTN infrastructure that might be used for telephony. The two linkages between the infrastructures reflect separate network connections for voice and signaling.

***90 Figure 2-Relationship between IP and PSTN Infrastructure Providers**

TABULAR OR GRAPHIC MATERIAL SET FORTH AT THIS POINT IS NOT DISPLAYABLE

Figure 3-Abstracted Telephony Interconnection Between Infrastructures

TABULAR OR GRAPHIC MATERIAL SET FORTH AT THIS POINT IS NOT DISPLAYABLE

The seven interconnection relationships (A through G) are further described in the following subsections. For cross-referencing purposes, the letter to the left of the section heading corresponds to the identifying letter used in Figures 1 and 2.

a) Access Provider to Access Provider

For purposes of example, consider two access providers. The first is facilities-based, owns fiber to the home, and offers an access service such as Gigabit Ethernet. The second access provider is not-facilities based, and wants to offer a competing Gigabit Ethernet service on a wavelength of its competitor's fiber facility. [FN57] The interconnection relationship between these two providers is of interest to policy makers to ensure that there is competition in the access markets.

***91** b) Access Provider to Transport Provider

These relationships establish the interconnection of the access networks to the backbone service providers, as well as to other services. Whether or not these two providers are actually the same company is irrelevant here. The point is that the end user may wish to make use of different transport providers. This ability to choose should encourage a competitive market.

c) Transport Provider to Transport Provider

These relationships establish the interconnected IP transport infrastructure. The relationships are typified by the peering and transit arrangements for traffic exchange that exist amongst backbone network providers (e.g., WorldCom) and access ISPs (e.g., EarthLink). [FN58] Interdomain QoS interconnections fall into this relationship category as well. Application services that these same providers may offer (such as EarthLink's email service) are not included in the transport to transport provider relationship.

d) Transport Provider to Application Service Provider

These relationships enable application service providers to access the transport networks that carry their traffic. Examples of these relationships include those between (but are not limited to):

- Transport providers and content providers
- Transport providers and caching / storage providers
- Transport providers, and electronic mail and web hosting service providers
- Transport providers and new application providers.

It is important to recognize that new applications can quickly enter this space and radically change the landscape. Napster is an example of such an application. In less than a year, Napster raised a number of legal, policy, and architectural issues. It is this dynamic nature of the Internet that requires the government to use prudence when considering policy that impacts the Internet.

***92** e) Application Service Provider to Application Service Provider

The end user subset of the Applications Services market sector is characterized by low economies of scale. This factor (together with others) should keep this market sector competitive. Intermediate applications, however, such as those that facilitate end user applications (e.g., telephony signaling, directory services, caching) may become important from a public policy perspective if a single provider dominates and has the power to thrive without interconnection to other application service providers.

f) Application Service Provider to Content Provider

While in the traditional media outlets, such as television and radio, the large conglomerates dominate the distribution of content, this need not be the case on the Web. This will help keep the content services market competitive. What could potentially become a policy concern is a scenario in which a dominant search engine uses its power to manipulate search results, while operating outside the reach of regulation. [FN59]

g) Internet Services Provider to Telecommunications Service Provider

For the foreseeable future, the emerging IP infrastructure needs to interconnect with selected parts of the legacy PSTN infrastructure. With the current regulatory status of Internet Services as information services, a telecommunications service provider with market power may be able to erect barriers to entry. These barriers may include restricted access to rights-of- way, restricted access to signaling for call routing and completion, and restricted access to 911/E911 services. [FN60]

2. Transition

The FCC's High Speed Access Notice of Inquiry ("NOI") [FN61] suggests that the FCC is starting to think about regulation in a ***93** more unified manner. [FN62] A rather forward-thinking aspect to this NOI was the cross-bureau nature of the effort. The document was the joint work of individuals in the Cable and Common Carrier Bureaus, the Office of Engineering and Technology and the Office of Plans and Policy. This might be an indication that the FCC is taking a first step to resolving some of the policy inconsistencies through the record-making process. Another indication of transition is that the FCC has begun to reorganize the structure of its bureaus to better serve the public and industry, abandoning strict conformity with the title structure of the Communications Act. [FN63] In spite of all of this, there is only so much the FCC can do without statutory changes.

Of course, the cost of major regulatory change is of paramount concern to the industry. It is difficult to know what and where the costs will be, but there is no doubt that these decisions could involve the flow of large sums of money. An interesting question to consider is whether the previous lack of regulatory clarity has had a negative impact on investment and other such measures of economic benefit. For example, has the lack of defining IP telephony resulted in less investment, or has it allowed markets to develop that would otherwise never have had a chance to develop? What might have occurred if IP telephony (in any form) was defined and regulated as a telecommunications service? [FN64] This paper does not answer these questions, but presents them only as a reminder of the economic impact of regulatory decisions.

CONCLUSIONS

This paper sets forth many of the issues that legislators and regulators must deal with prior to transitioning from the current, inadequate regulatory model to a more suitable model. In particular, policy makers need to be explicit about their goals, and they must sufficiently define the terms they use in their effort to implement appropriate policy. It will take a great deal of careful thought to create a model that continues to serve our policy goals while withstanding rapid technological innovation and deployment.

***94** This paper proposes a modified layered framework for telecommunications policy that focuses closely on interconnection issues. This framework provides a structure within which interconnection issues can be systematically identified and interpreted by distinguishing between IP access and transport services, applications, and content that use these transport services. It is our hope that this framework can serve as a tool with which policy makers can contemplate new models of policy.

Regardless, however, of whether one makes use of this framework, it is important that policy makers appreciate the interconnection issues. Stated another way, it is important that the significant and sometimes subtle issues associated with interconnection not be abstracted away when considering the use of a communications protocol stack as a potential regulatory framework.

With a general intention of moving toward a layered model, policy makers should focus on unifying the policymaking process. During the transition period, regulators can advance this policy within the terms of the present legislative model, however, in the long run, Congress should take on a major revision of the Communications Act.

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[FN1]. Telecommunications Act of 1996, Pub. L. No. 104-104, 110 Stat. 56 (codified in scattered sections of 15, 18 and 47 U.S.C.) [hereinafter 1996 Act]. The 1996 Act amended the Communications Act of 1934, Pub. L. No. 73-416, 48 Stat. 1064 (codified as amended at 47 U.S.C. ß ß 151-614 (2000), and scattered sections of 47 U.S.C.) [hereinafter Communications Act].

[FN2]. See 47 U.S.C. ß ß 521-73 (2000).

[FN3]. See 47 U.S.C. ß ß 201-76 (2000).

[FN4]. See F.M. Bar, Configuring the Telecommunications Infrastructure for the Computer Age: The Economics of Network Control (1990) (unpublished Ph.D. thesis, University of California, Berkeley); D.C. Sicker, J. Mindel, & C. Cooper, THE INTERNET INTERCONNECTION CONUNDRUM (unpublished FCC working paper, 1999); Kevin Werbach, A Layered Model for Internet Policy, The Regulation of Information Platforms, 1 J. TELECOMMS. & HIGH TECH. L. 37 (2002); Jonathan Weinberg, The Internet and Telecommunications Services, Universal Service Mechanisms, Access Charges and Other Flotsam of the Regulatory System, Telecommunications Policy Research Conference (1998), available at http:// www.law.wayne.edu/weinberg/FLOTSAM.a04.PDF.

[FN5]. A protocol defines a language of rules and conventions for communications between entities. Communications protocols are defined as a series of layers, which together provide the means for communications on networks. Layers allow for modularity of design. This allows functions to be divided into well-defined and manageable tasks.

[FN6]. M.A. Sirbu. & J. Mindel, New Regulatory Categories in the Age of Convergence, Next-Generation Internet Policy Workshop, European Commission, Brussels (Sept. 16-17, 1999), available at http:// www.gip.org/publications/papers/ngibrusselsreport.asp.

[FN7]. See JASON OXMAN, THE FCC AND THE UNREGULATION OF THE INTERNET (FCC, OPP Working Paper No. 31, July 1999), available at http:// www.fcc.gov/Bureaus/OPP/working_papers/oppwp31.pdf.

[FN8]. See 1996 Act, supra note 1.

[FN9]. See Implementation of Sections 255 and 251(a)(2) of the Communications Act of 1996, Report and Order and Further Notice of Inquiry, 16 F.C.C.R. 6417 (1999).

[FN10]. The First Local Competition Order put forth by the Commission in 1996 was more than 700 pages long. See Implementation of the Local Competition Provisions in the Telecommunications Act of 1996, First Report and Order, 11 F.C.C.R. 15499 (1996). Many regulatory steps have been taken, including efforts in local number portability, dial parity, collocation, line sharing and more.

[FN11]. 47 U.S.C. ß 153 (2000). The 1996 Act differentiates between information and telecommunications services as a mechanism to accommodate certain services that Congress wanted to keep relatively free from regulation.

[FN12]. An IP transport service is defined as the connectionless data delivery service offered by IP packet-routed networks.

[FN13]. 47 U.S.C. ß 153 (43) (2000).

[FN14]. At least one study has done a detailed analysis of the interconnection obligations (and benefits) that would be triggered by such a reclassification, and suggests which of them are suitable for the provision of IP backbone services. See J.L. Mindel & M.A. Sirbu, Regulatory Treatment of IP Transport Services, in COMMUNICATIONS POLICY IN TRANSITION: THE INTERNET AND BEYOND 59 (B.M. Compaine & S. Greenstein eds., 2001).

[FN15]. State regulators cannot act under a provision of the statute if the FCC has decided to forbear from acting. 47 U.S.C. 160(e) (2000).

[FN16]. Consider the optical control plane standards now emerging. Future interconnection policy issues between national backbone providers will vary depending on the particular set of competing standards that is ultimately adopted and deployed by the industry.

[FN17]. It is a common misconception that the Internet is completely unregulated today. In fact, parts of it are regulated. For example, many of the underlying telecommunications circuits upon which the Internet runs are provided by regulated telecommunications service providers. Further, decisions not to impose "open access" on the cable industry represent policy making in the negative sense, by way of deciding not to regulate. A related misconception is that the Commission has no authority with respect to information service providers, such as Internet Service Providers (ISPs). The Commission explicitly acted on behalf of ISPs in its decisions to exempt ISPs from access charges. See OXMAN, supra note 7.

[FN18]. See generally, Robert Cannon, The Legacy of the FCC's Computer Inquiries: 35 Years of Unregulation, WASHINGTON INTERNET PROJECT, at www.cybertelecom.org. For more on the first Computer Inquiry, see Regulatory and Policy Problems Presented by the Interdependence of Computer and Communication Services and Facilities, Notice of Inquiry, 7 F.C.C.2d 11 (1966) [hereinafter Computer Inquiry].

[FN19]. These standards are developed in a process that incorporates input from a wide range of interested parties.

[FN20]. Architecture is modular enough to accommodate updates to one component without requiring updates to interfaces or other components.

[FN21]. Interconnection is technically possible and economically feasible.

[FN22]. System is interoperable with those systems implemented using another vendors' technology; this is closely related to standards.

[FN23]. Directories are accessible to potential competitors for reading and modifying, subject to legitimate authentication and payment procedures.

[FN24]. This represents common standards for the integration of software applications. This may include APIs within a framework, or the framework itself.

[FN25]. Source code is publicly available; open code does not imply that code is free or intellectual copyright restrictions do not apply.

[FN26]. Content is accessible to all users of the Internet. Content is not inside a walled-garden. This does not imply that content is free.

[FN27]. See 47 U.S.C. ß 271 (2000) (This represents Congress' most recent attempt).

[FN28]. See id. at (a) and (c)(A) (Section 271 provides that a Bell operating company may not provide interLATA (long distance) services unless it provides access and interconnection to its network facilities to a competing provider).

[FN29]. See id. at (c)(2) (specific interconnection requirements).

[FN30]. Consider the time and effort exerted by all sides (incumbent carriers, competitors, Federal and State regulators) in the ß 271 application process.

[FN31]. See J.H. Saltzer, D.P. Reed & D.D. Clark, End-to-End Arguments in System Design, available at http://www.reed.com/Papers/EndtoEnd.html (1984); David Clark & Marjorie Blumenthal, Rethinking the Design of the Internet: The End-to-End Argument vs. the Brave New World, in COMMUNICATIONS POLICY IN TRANSITION: THE INTERNET AND BEYOND 91 (B.M. Compaine & S. Greenstein eds., 2001), available at http://www.tprc.org/abstracts00/rethinking.pdf.

[FN32]. Most modern telecommunications protocols have layered protocols. For example, the voice network operates on a layered model.

[FN33]. Werbach, supra note 4.

[FN34]. LAWRENCE LESSIG, THE FUTURE OF IDEAS 23 (2001).

[FN35]. See PATRICK DEGRABA, BILL AND KEEP AT THE CENTRAL OFFICE AS THE EFFICIENT INTERCONNECTION REGIME, (FCC, OPP Working Paper No. 33, Dec. 2000), available at http://www.fcc.gov/Bureaus/OPP/working_papers/oppwp33.pdf.

[FN36]. For example, an application like voice might need quality of service capabilities from the physical layer and naming/numbering from other application layers. Layer interaction and layer dependency will become an important issue should we embrace a layered model of regulation.

[FN37]. 47 U.S.C. ß 256 (2000).

[FN38]. See id. at (b)(2).

[FN39]. See IEEE 802 Working Group Home Page, IEEE at http:// grouper.ieee.org/groups/802/dots.html (last visited Aug. 15, 2002).

[FN40]. See Cable Labs Home Page, CABLE LABS at http://www.cablelabs.com (last visited Aug. 15, 2002) (under current projects).

[FN41]. While the Internet Engineering Task Force (IETF) is responsible for Internet specifications, we view this as outside the scope of access technology.

[FN42]. See DEGRABA, supra note 35.

[FN43]. See Letter from Roy L Morris, US ONE, to Reed Hundt, Chairman, FCC, Recommendation for Commission Actions Critical to the Promotion of Efficient Local Exchange Competition, (Aug. 11, 1997) at http:// members.aol.com/RoyM11/LoopCo/LoopCoLetter.html [hereinafter Letter].

[FN44]. See REED HUNDT, YOU SAY YOU WANT A REVOLUTION: A STORY OF INFORMATION AGE POLITICS (2000). The former Chairman of the FCC contends:

Behind the existing rules, however, were two unwritten principles. First, by separating industries through regulation, government provided a balance of power in which each industry could be set against one another in order for elected figures to raise money from the different camps that sought advantageous regulation. Second, by protecting monopolies, the Commission could essentially guarantee that no communications businesses would fail. Repealing these implicit rules was a far less facile affair than promoting competition.

Id., at 14.

[FN45]. See Letter, supra note 43. The LoopCo model advanced in the Letter proposed that each of the incumbent LEC networks be divested into two companies -- one that would provide the local loop from the central office out to the customer and one that would provide the switching and other services. Id. The idea being that the loop company would not be inclined to treat competitive providers of the switching and other services in an anticompetitive manner.

[FN46]. Gerald R. Faulhaber, Policy-Induced Competition: The Telecommunications Experiments, available at http://rider.wharton.upenn.edu/~ faulhabe/PolicyInduced%20Competition.pdf (Aug. 26, 2001).

[FN47]. See America Online, Inc. and Time Warner Inc., Complaint, 2000 F.T.C. Lexis 170 (2000).

[FN48]. See id.; see also Applications for Consent to the Transfer of Control of Licenses and Section 214 Authorizations from Tele-communications, Inc., Transferor to AT&T Corp., Transferee, Memorandum Opinion and Order, 14 F.C.C.R. 3160 (1999).

[FN49]. Providing a "raw" connection to the Internet makes many assumptions about the design of a network and the functionality required to provide that "raw" connection. The notion of a raw bit pipe assumes away many of the functions that must be performed in certain architectures in order to provide a service.

[FN50]. See 47 U.S.C. ß 706 (2000).

[FN51]. See 1996 Act, supra note 1.

[FN52]. MICHAEL KENDE, THE DIGITAL HANDSHAKE: CONNECTING INTERNET BACKBONES (FCC, OPP Working Paper No. 32, Sept. 2000), available at http:// www.fcc.gov/Bureaus/OPP/working_papers/oppwp32.pdf.

[FN53]. See Inquiry Concerning High-Speed Access to the Internet Over Cable and Other Facilities, Notice of Inquiry, 15 F.C.C.R. 19287 (2000) [hereinafter Open Access NOI].

[FN54]. Sicker, supra note 4.

[FN55]. A GigaPOP, unlike a NAP, is a layer three interconnection point that allows for aggregation of resources and access to services in a cost effective manner.

[FN56]. Although they are subject to Section 255 (Disability) of the Communications Act, 47 U.S.C. ß 255 (2000) and the Communications Assistance to Law Enforcement Act (CALEA), 47 U.S.C. ß 1002 (2000).

[FN57]. This example was inspired by on-going research on competition in the last mile by A. Banarjee and M.A. Sirbu at Carnegie Mellon University.

[FN58]. See Sicker, supra note 4 (discussing traffic exchanges); see also KENDE, supra note 52.

[FN59]. See John Naughton, Why Google Leaves Just Leaves Everybody Goggling, LONDON OBSERVER, Jan. 27, 2002, available at http:// www.observer.co.uk/business/story/0,6903,639855,00.html (expressing concern about the growing predominance of the Google Search engine). We have also based this on a Fall 1999 conversation with M.A. Sirbu.

[FN60]. Mindel & Sirbu, supra note 14.

[FN61]. Open Access NOI, supra note 53.

[FN62]. While many refer to the NOI as the Cable Open Access NOI, it is in fact, an inquiry into all forms of high-speed access.

[FN63]. See FCC Chairman William E. Kennard, Draft Strategic Plan: A New FCC for the 21st Century at http://www.fcc.gov/21st_century/draft_strategic_ plan.txt (Aug. 1999).

[FN64]. Mindel & Sirbu, supra note 14.

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