MISUNDERSTANDING THE LAYERED MODEL(S)

DOUGLAS C. SICKER AND LISA BLUMENSAADT*

INTRODUCTION

While the general idea of a layered policy model continues to gain attention (both positive and negative), it is clouded by the development of numerous competing models.[1] The original layered model, described

* Douglas C. Sicker is an assistant professor in computer science and telecommunications at the University of Colorado at Boulder. Lisa Blumensaadt is an attorney specializing in telecommunication policy and intellectual property. Professor Sicker would like to thank the following individuals for their assistance with this paper: Dale Hatfield, Phil Weiser, the University of Colorado Journal on Telecommunications and High Technology Law and in particular Eric Lentell, my article editor.

1. The proponents include: Rob Frieden, *Adjusting the Horizontal and Vertical in Telecommunications Regulation: A Comparison of the Traditional and a New Layered Approach*, 55 FED. COMM. L.J. 207 (2003); John T. Nakahata, *Regulating Information Platforms: The Challenge of Rewriting Communications Regulation from the Bottom Up*, 1 J. TELECOMM. & HIGH TECH. L. 95 (2002); Douglas C. Sicker & Joshua L. Mindel, *Refinements of a Layered Model for Telecommunications Policy*, 1 J. TELECOMM. & HIGH TECH. L. 69 (2002); Philip J. Weiser, *Law and Information Platforms*, 1 J. TELECOMM. &

fully later, and herein referred to as the "Sicker-Mindel-Cooper"[2] ("SMC") layered model, was intended as a tool for examining policy implications on technology and later evolved into a policy model intended to promote a technically neutral view of the various emerging network platforms.[3] It was originally intended to be an analytical framework; however, the original motivation and design of this model has been misinterpreted and restated by other authors.[4]

Meanwhile, the paper which did the most to promote the idea of a layered model, the Whitt-MCI paper,[5] also presented the most controversial interpretation of it. The Whitt-MCI Paper created a lot of attention for the layered model, and brought layered models under severe criticism, since it advocates for a specific regulatory outcome. In short, the Whitt-MCI paper advocates regulatory intervention at the physical layer[6] and the continuation of unbundling the incumbents' telecommunications networks[7]. While it offers an excellent overview of

---

HIGH TECH. L. 1 (2002); Kevin Werbach, *A Layered Model for Internet Policy*, 1 J. TELECOMM. & HIGH TECH. L. 37, 39-40 (2002); Richard S. Whitt, *A Horizontal Leap Forward: Formulating a New Communications Public Policy Framework Based on the Network Layers Model*, 56 FED. COMM. L.J. 587 (2004); Lawrence B. Solum & Minn Chung, *The Layers Principle: Internet Architecture and the Law* (University of San Diego School of Law, Public Law and Legal Theory Research Paper No. 55, 2003), *available at* http://ssrn.com/abstract=416263. The opponents and critics include: Raymond Gifford, *The Uses and Misuses of the Layered Model*, THE SKEPTICAL REGULATOR (August 2004), http://www.pff.org/irle/skepticalregulator/skepticalregulator2.3.html; David P. Reed, *Critiquing the Layered Regulatory Model*, 4 J. TELECOMM. & HIGH TECH. L. 281 (2006); J. Scott Marcus, *The Potential Relevance to the United States of the European Union's Newly Adopted Regulatory Framework for Telecommunications* (FCC Office of Plans and Policy, Working Paper No. 36, July 2002), *available at* ftp://www.fcc.gov/pub/Bureaus/OPP/working_papers/oppwp36.pdf.; Wayne T. Brough et al., *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 Paper, July 2004), *available at* http://newmillenniumresearch.org/news/071304_report.pdf [hereinafter NMRC].

2. *See* Sicker & Mindel, *supra* note 1.

3. Douglas C. Sicker et al., *The Internet Connection Conundrum* (unpublished FCC Office of Plans and Policy, Working Paper, 1999) (on file with the Journal of Telecommunications & High Technology Law).

4. *See* Whitt, *supra* note 1.

5. *Id.*

6. *Id.* at 592 (stating "*the[MCI] Network Layers Model targets the lower network layers for discrete regulation* based on the existence of significant market power, rather than legacy service or industry labels. This framework concomitantly fosters maximum innovation by leaving otherwise competitive content and applications markets unfettered by regulation.") (emphasis added). The physical layer refers to the underlying physical infrastructure that carries communications signals, such as the cable and associated facilities carrying cable television signals.

7. *Id.* at 649. ("Section 251(c) of the Telecommunications Act of 1996, which requires the ILECs (Incumbent Local Exchange Carriers) to provide unbundled network elements ("UNEs"), can be an important legal mechanism in service of the [MCI] layers principle."). ILECs, a term created by the Telecommunications Act of 1996, are "local exchange carriers" that provided "local exchange service" prior to the enactment of the Telecommunications Act

prior work in the area, the paper concludes with a position that strongly aligns with the policy desires of competitive local exchange carriers (CLECs), specifically their desire to unbundle the local loop[8]. In turn, this position has met with great resistance by various segments of the policy community.[9] As a result, critics of the layered approach focus their energies on the shortcomings of the Whitt-MCI model, yet fail to engage in a rigorous discussion of the general concept of a layered policy model.

Subsequent to the SMC layered model other layered models were developed; however, these models differ in the division of the layers and how they view the value of the divisions. In particular, Whitt,[10] Marcus,[11] Werbach,[12] Reed,[13] Gifford[14] and the New Millennium Research Council ("NMRC")[15] examined layered policy approaches and developed variations or critiques of such models.

The goal of this paper is to demonstrate that a layered model is still a useful framework for policymaking in the current environment. Section II provides background on the original intent of the SMC layered model and describes the current regulatory model and the technical underpinnings of layered models (the Open System Interconnection [OSI] Stack and Transmission Control Protocol/Internet Protocol [TCP/IP] Suite). Section III reviews the details of the SMC layered policy model and summarizes and addresses the major points of critical analysis and provides a brief descriptive review of the other major layered policy models. It then discusses how the

---

of 1996, 47 U.S.C. § 251(h) (2005) [hereinafter 1996 Act]. They are commonly thought of as local telephone companies or the "Baby Bells," and are the long-existing owners of the physical local communications networks. This term is used in conjunction with the term Competitive Local Exchange Carrier (CLEC), which is a new local exchange carrier trying to compete with the well-established traditional local telephony service providers (ILECs). UNEs, or unbundled network elements, are discrete portions of a local exchange network that together make up a loop connecting the local telephone company office equipment to residential or businesses' communications equipment. UNEs were created by the 1996 Act and subsequently specifically defined by a Federal Communications Commission Order to engender competition in the provision of local communications services by allowing CLECs to make cost-based purchases of discrete portions of the physical local network that they needed in order to provide local communications services in competition with the ILECs without having to build out their own redundant physical network. 1996 Act, 47 U.S.C. § 251(c)(3) (2005); Implementation of the Local Competition Provisions in the Telecomm. Act of 1996, *First Report & Order*, 11 FCC Rcd. 15,499 (1996).

8. *See* Whitt, *supra* note 1, at 649.

9. NMRC, *supra* note 1. *See also* Reed, *supra* note 1; Gifford, *supra* note 1.

10. *See* Whitt, *supra* note 1.

11. *See* Marcus, *supra* note 1.

12. *See* Werbach, *supra* note 1.

13. *See* Reed, *supra* note 1.

14. *See* Gifford, *supra* note 1.

15. *See* NMRC, *supra* note 1.

SMC layered policy model, based on the layered structure of communications networks, is still valid and useful as a framework for examining policy implications. The section ends by articulating the ways in which the layered policy models remain relevant. The paper concludes in Section IV with a summary of the likely layers that will emerge in future regulatory frameworks.

I. THE LAYERED MODEL

A. *Original Intent of the SMC Layered Policy Model*

The SMC model began as a simple intellectual exercise with the intent to describe the way that networks actually operate for regulators wrestling with applying policy. Communications evolved into vastly different networks from those the existing regulatory framework was designed to address. Policymakers struggle to apply an outdated regulatory framework to the new communications networks, where the physical structure of the networks no longer fit the regulatory structure. Furthermore, segments of the network now operate under very different market conditions than existing regulations assumed. Joshua Mindel, Cameron Cooper and Douglas C. Sicker described the original layered model in an unpublished paper written in 1999 while working for the Federal Communications Commission (FCC).[16] Later, the concept evolved into an analytical policy tool, one in which networks were assessed in a technically neutral manner with a focus on detecting where market abuse might occur.

The original idea behind the layered concept was not about creating a new regime for regulation, but rather to function as an analytical tool for evaluating how to regulate evolving networks. The goal was to move toward technical neutrality and therefore, consistent treatment. This could be achieved through regulation based on the service, rather than of the network infrastructure that carries the service. An additional objective was to define a model where the application layer could continue to innovate by avoiding unintentional regulation.

B. *Current Regulatory Structure – A Review*

The current communications regulatory structure is often described as a "silo" model, with regulation of a service closely associated with the underlying physical infrastructure on which a service is offered. There is a separate "silo" associated with each platform –wireline (twisted copper pair), cable (coaxial) or spectrum (wireless). For example, voice

16. *See* Sicker et al., *The Internet Connection Conundrum*, *supra* note 3.

(telephony) service delivered over wireline (copper twisted pair) is regulated under Title II – Common Carrier[17], but voice service delivered over spectrum (wireless) is regulated under Title III –Wireless. Thus the same service, voice, is regulated differently according to the physical infrastructure over which it is delivered. It is important to note that the regulation is not based on the platform or the service. For example Title II is a common carrier regulation, not necessarily a wireline or a voice regulation; however the platforms, the services and the titles have certainly become synonymous.

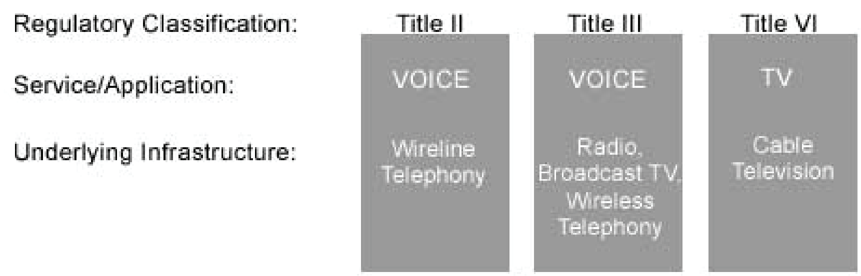

Figure 1. The current "silo" regulatory structure

This regulatory model was constructed around the technological and market conditions that existed at the time the laws were passed. For many decades, telephony service was a monopoly industry provided largely by one company, AT&T. It was thought to be far too expensive, unprofitable and inefficient for competing companies to redundantly lay tens of thousands of miles of wire and build the associated facilities to provide competing telephony service. Thus, modeling telephony regulation after existing "common carrier" regulation -like train service or a utility- made sense.

The system of regulation that developed around the evolving technology initially made a lot of sense. However, regulatory disparities began to emerge as cable television became a competitor to broadcast television and cellular (telephony) service began to replace wireline telephony use. Thus, similar services delivered over different infrastructure are regulated by disparate regulations.

The real difficulties, however, have developed with what many refer

17. *See generally* 47 U.S.C. § 202 (1989); 47 U.S.C. § 153 (1997) (stating "The term "common carrier" or "carrier" means any person engaged as a common carrier for hire, in interstate or foreign communication by wire or radio or in interstate or foreign radio transmission of energy, except where reference is made to Common carriers not subject to this Act; but a person engaged in radio broadcasting shall not, insofar as such person is so engaged, be deemed a common carrier.").

to as "convergence" and the "digital revolution." Services are said to "converge" onto a single superstructure that could ride over all existing physical infrastructures –the Internet Protocol (IP) environment. In this environment, cable can deliver voice service and high-speed internet service, as well as television service; wireline telephony providers can deliver video service, high-speed internet service, and voice service; wireless telephony providers can also deliver internet service, streaming video and other services; and voice service, audio or video broadcasts, streaming video, audio downloads and more services can be delivered over the Internet, provided by ISPs -unaffiliated or affiliated with a cable company (over cable modem), or a phone company (over dial-up or DSL), or by a competitive provider (over leased dial-up or DSL facilities of the incumbent phone company). As each new service evolves, there is a need to classify it in order to determine under which regulations it falls. Regulating based on the infrastructure or associated title, however, no longer seems appropriate when each infrastructure can deliver a multitude of competing services. Entities provide competing services to consumers who do not generally distinguish between the same service delivered over different infrastructures. This differing infrastructure, however, causes these entities to operate under vastly disparate regulatory conditions.

The FCC tried to deal with regulation of nascent computer networks in *Computer Inquiry I*,[18] *II*[19] and *III*,[20] first by creating *basic* and *enhanced* service classifications. Basic services –"the common carrier offering of transmission capacity for the movement of information"[21] fell under common-carrier regulation and enhanced services remained unregulated.[22] This was the beginning of a layered model approach, as it established a separation of the transport network from services.[23] The Telecommunications Act of 1996 addressed this issue in legislation by defining a *telecommunications service* as "the offering of telecommunications for a fee directly to the public, or to such classes of users as to be effectively available directly to the public, regardless of the

18. Regulatory & Policy Problems Presented by the Interdependence of Computer and Communication Servs. & Facilities, *Notice of Inquiry*, 7 F.C.C.2d 11, ¶ 1 (1966) [hereinafter *Computer I*].

19. Amendment of Section 64.702 of the Comm'n's Rules and Regulations (Second Computer Inquiry), *Final Decision*, 77 F.C.C.2d 384 (1980) [hereinafter *Computer II*]

20. Amendment of Section 64.702 of the Comm'n's Rules and Regulations. (Third Computer Inquiry), *Report & Order*, 104 F.C.C.2d 958 (1986) [hereinafter *Computer III*].

21. *Computer II*, *supra* note 19, at ¶ 93..

22. *Id.* at ¶¶. 100–01.

23. *See* Douglas C. Sicker, *Further Defining a Layered Model for Telecommunications Policy*, Paper Presented at the Telecommunications Policy Research Conference 2002, at 5, *available at* http://intel.si.umich.edu/tprc/papers/2002/95/LayeredTelecomPolicy.pdf.

facilities used"[24] and an *information service* as "the offering of a capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing, or making available information via telecommunications."[25]

Although these attempts were made to deal with a rapidly changing telecommunications landscape, minor regulatory overlays are not sufficient to fix the disparity caused by the inherited regulatory structure and the vastly changing communications environment. Thus, it is generally agreed that the current regulatory model no longer fits existing conditions. The layered model presents a possible framework with which to examine policy issues going forward.

C. Layered Model Description[26]

In this section, we provide a brief overview of the basic ideas behind protocol layering. We also describe the Open System Interconnection (OSI) and Transmission Control Protocol/Internet Protocol (TCP/IP) models. We then describe the SMC concept of the layered model for policy.

1. Protocol Layering

A computer network can be conceived of as the interconnections of computers that allow communication. The content, scope, size, speed and reliability of the network vary depending on its protocols and implementation. *Protocols* are pre-established rules or means of communication. They are simply a set of valid messages, rules and formats that govern the communication among peers.[27] Protocol layering is a common technique to simplify networking designs by dividing them into functional layers, and assigning protocols to perform each layer's task. Protocol layering produces a number of sub-functions, each with well-defined tasks. The concept of layering relies on breaking a complex task into smaller subsets, each of which addresses a specific issue. Each layer provides a well-defined set of services to the layers above it and depends on lower layers for its own operation, thus creating modularity.[28] The Internet protocols are arranged in essentially

---

24. 47 U.S.C. § 153 (46) (2005).

25. 47 U.S.C. § 153 (20) (2005).

26. This section substantially draws upon one of our original articles on the subject,, which more explicitly addressed the foundations of a layered model. *See* Sicker et al., *The Internet Connection Conundrum*, *supra* note 3.

27. For a detailed explanation of protocol Layering, *see* SRINIVASAN KESHAV, *Protocol Layering, in* AN ENGINEERING APPROACH TO COMPUTER NETWORKING: ATM NETWORKS, THE INTERNET, AND THE TELEPHONE NETWORK 67 (1997).

28. *See generally* Connected: An Internet Encyclopedia, *Protocol Layering*, http://www.freesoft.org/CIE/Course/Section1/4.htm (last visited Mar. 6, 2006).

independent layers with the Internet Protocol (IP) itself at the "waist" of the stack. The protocol stack broadens above the waist to support a wide range of transport and application layers including email, the Worldwide Web, file transfer protocols, remote login, etc. The protocol stack broadens below the waist to ride on a wide range of underlying networks using a variety of technologies including Ethernet, frame relay, ATM, ADSL, fiber optic systems, and so on. The modularity, coupled with well-understood specifications, facilitates the introduction of new technologies and new applications, thereby stimulating growth. Modularity also promotes an environment wherein providers compete with products that will interoperate.

2. Open System Interconnection (OSI) Stack

The International Organization for Standardization (ISO) created the seven-layer Reference Model of Open System Interconnection to describe networked systems. Each of these layers has a set of specific functions associated with it, as depicted in Figure 2 below:

Physical: covers the network hardware, physical cabling and signal specifications.

Data Link: attempts to make the physical link reliable and provides the means to activate, maintain and deactivate the link.

Network: provides for transfer of packets between end systems across a communications network.

Transport: provides a mechanism for the reliable, transparent exchange of data between end-points across a network.

Session: provides the mechanism for controlling the dialogue between applications in end systems, such as starting and terminating sessions.

Presentation: defines the format of the data to be exchanged between different applications and offers application programs a set of data transformation services.

Application: provides entry points for user programs to control transmission of data to and from other machines. It contains management functions and generally useful mechanisms to support distributed applications. [29]

29. For a detailed explanation of the OSI reference model and description of each layer, *see* WILLIAM STALLINGS, DATA AND COMPUTER COMMUNICATIONS 51-54 (6th ed. 2000).

3. Transmission Control Protocol/Internet Protocol (TCP/IP) Suite

The term TCP/IP (Transmission Control Protocol/Internet Protocol) suite actually refers to a whole family of protocols, of which TCP and IP are just two. TCP/IP, which began development in 1969 by the U.S Department of Defense Advanced Research Projects Agency (DARPA), is an industry-standard suite of protocols designed to provide internetworking. TCP/IP protocols map to a four-layer conceptual model also known as the DARPA model, named after the aforementioned U.S. government agency. The four layers of the TCP/IP suite are: Network Interface, Internet, Transport and Application. Each layer in the TCP/IP suite corresponds to layers in the OSI model.[30]

Network Interface Layer: The network interface layer is the lowest layer in the Internet reference model. It corresponds to the physical and data link layers of the OSI model. This layer contains the protocols used to deliver data to the other computers and devices that are attached to the network. TCP/IP was designed to be independent of the network access platform. In this way, TCP/IP can be used to connect differing network technologies such as Ethernet, ATM or Frame Relay. Independence from any specific network technology gives TCP/IP the ability to be adapted to new technologies.

Internet Layer: This layer is responsible for routing messages through networks. The Internet layer is similar to the Network layer of the OSI stack explained earlier.

Transport Layer: The protocol layer just above the Internet layer is the transport layer. It is responsible for the reliability and integrity of the end-to-end communications. It is similar to the transport layer of the OSI stack mentioned earlier.

Application Layer: The application layer is the highest layer of the TCP/IP protocol stack. It maps to the upper three layers of the OSI model. It provides applications the ability to access the services of the other layers and defines the protocols that applications use to exchange data.[31]

The TCP/IP protocol suite is quite similar to the OSI reference model and each contributed to the other. The main differences between the OSI architecture and that of TCP/IP relate to the layers above the

---

30. *See* MICROSOFT CORP., INTRODUCTION TO TCP/IP, http://www.microsoft.com/ntserver/zipdocs/TCPIntrowp.doc (last visited Mar. 6, 2006).

31. *See* CISCO SYSTEMS, INC., UNDERSTANDING TCP/IP, http://www.cisco.com/univercd/cc/td/doc/product/iaabu/centri4/user/scf4ap1.pdf (last visited Mar. 6, 2006).

transport layer (layer 4) and those below the network layer (layer 3). OSI has both the session layer and the presentation layer, whereas TCP/IP combines them into the application layer. Also, TCP/IP combines OSI's physical layer and data link layer into a network interface level. In reality, the TCP/IP model is agnostic to what exists below layer 3; however, it is common to see it referred to as the network interface The figure below shows the basic layering approach in both the schemes.

The intention of the SMC layered model was to start with a model that technologists use to conceptualize the hardware and software associated with a network (i.e., protocol layers) and use this as a framework for describing a new way of viewing long term policy decisions. We originally examined the direct applicability of the TCP/IP prot ocol suite and the OSI reference model to this task. See Figure 2.

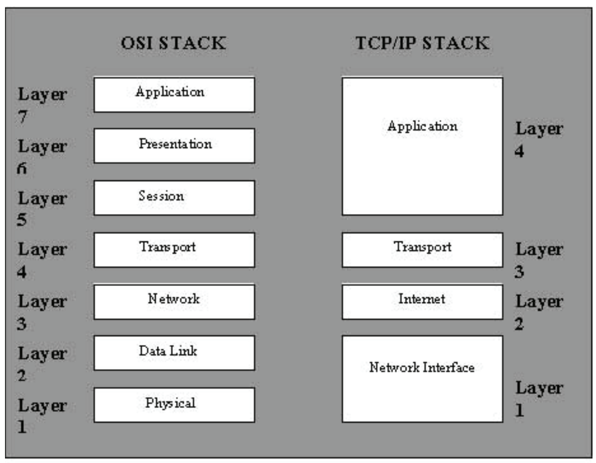

Figure 2. The OSI and TCP/IP Models

4. The SMC Layered Model as it relates to Policy

While other models are essential in developing the hardware and software associated with a network, they often fail to capture the reality of the policy issues or network and market conditions. In essence, there are layers in these models that do not directly relate to policy issues or market reality. However, by using a more simplified model, a more realistic model of network and market concerns is developed. Thus, the SMC layered policy model considers the layers that are typically associated with the various devices in the network and those related to policy issues or market realities. The layers in the SMC model represent providers of services, not the protocols or the implementation of these protocols.[32]

Services and service providers are the focus of the SMC model, rather than those parties that might develop the products and services on behalf of the service providers.[33] The service layers distinguish among types of 1) physical services (e.g., access, transport), 2) application services (e.g., directories, caching, voice, electronic mail), and 3) content (e.g., music, video programming). These categories are described below:

Physical service providers are providers of 1) Access and 2) Transport services, including both best-effort and QoS services.[34]

Applications service providers are providers of application services that rely on underlying access and transport services and could be further subdivided into three subcategories: 1) directory service providers (e.g., DNS and other naming/numbering functions); 2) intermediate or middle service providers (e.g., multicasting and caching); and 3) end user service providers (e.g., voice, email, and hosting). One could argue that these three subcategories are distinct and should be treated as 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 applications that use or support the data delivery service.[35]

Content providers are providers of content who rely on underlying Transport, Access, Application services. Examples of content include video, music, and telephony services.[36]

The SMC layered policy model distinguishes between a transport and access layer, where most models collapse this into a single transmission layer. Earlier work on the SMC layered policy model notes that "[t]he separation we describe between the access and transport providers maps to the design of networks."[37] The transport layer encompasses the "long-haul" or backbone portion of the network, which operates on large scale movement of data in a competitive market. Meanwhile the access layer encompasses the "last-mile," which is a fairly non-competitive market that uses different technology and operates on a much different scale. These are separate markets that operate

32. *See* Sicker, *Further Defining a Layered Model for Telecommunications Policy, supra* note 23, at 10.

33. 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.

34. *See* Sicker & Mindel, *supra* note 1, at 16.

35. *Id.*

36. *Id.*

37. *See* Sicker, *supra* note 23, *Further Defining a Layered Model for Telecommunications Policy*, at 12 (noting that "[e]ven future policy such as the Bill and Keep model maintains this division") (citing Patrick DeGraba, *Bill and Keep at the Central Office as the Efficient Interconnection Regime* (FCC Office of Plans and Policy, Working Paper No. 33, Dec. 2000), *available at* http://www.fcc.gov/osp/workingp.html).

fundamentally differently and exist under vastly different market conditions. As such, access and transport should be denoted by separate layers. However, in the future this distinction may become irrelevant. As stated in our earlier work,

> The separation of the access network from the transport network . . . is critical to the success of this model. By making this division, the proper incentives could be introduced (through regulation or economic incentive) to encourage providers of the various services to interconnect on reasonable terms.[38] See Figure 3 below.

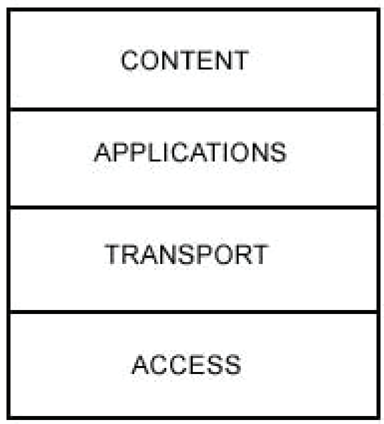

Figure 3.
The SMC Layered Policy Model

This layered stack provides a framework for systematic evaluation of the relationships between the layers. The important provider relationships are:

A - Access Provider to Access Provider
B - Access Provider to IP Transport Provider
C - IP Transport Provider to IP Transport Provider
D - IP Transport Provider to Application Service Provider
E - Application Service Provider to Application Service Provider
F - Application Service Provider to Content Provider
G – Internet Service Providers to Telecommunications Service Provider[39]

Relationships A through F are depicted in Figure 3a. An application service provider may directly connect with an access provider,

38. *See* Sicker, *supra* note 23, *Further Defining a Layered Model for Telecommunications Policy*, at 11.
39. *See* Sicker & Mindel, *supra* note 1, at 17.

but for purposes of simplification we leave this relationship out.

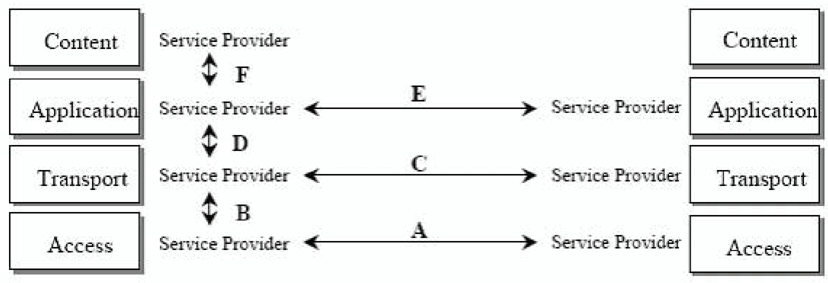

Figure 3a: Relationships among Infrastructure Service Providers

Figure 3a should be viewed as a conceptual model of the relationships between layers and service providers.

From a telecommunications policy perspective – and the perspective of this paper in particular – these are the relationships of primary interest. For example, an IP transport provider will use applications on their network, but since what they offer (to the public for a fee) is the transport service, the transport is the service of interest. Similarly, an application provider will employ network infrastructure (access and transport) to connect their applications to the public network, but the service is the application, not their network.[40]

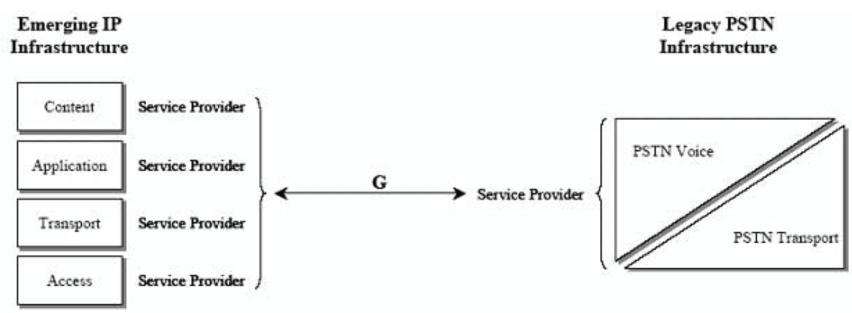

Figure 3b: Relationship between IP and PSTN Infrastructure Providers

Figure 3b depicts the 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.

40. For more on the details of this model, *see* Sicker et al., *The Internet Connection Conundrum*, *supra* note 3.

In Figure 3b,[41] 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.

In summary, the SMC layered policy model concept was not about creating a new regime for regulation, but rather developing a tool for looking at networks in a more technically neutral and consistent manner. The model consisted of 4 layers, the access, the transport, the application and the content and stressed the notion of the application layer being a highly innovative layer; one that should be allowed to evolve with minimal regulatory interference, while preserving its open and developmentally accessible nature.

II. REVIEW OF THE SMC LAYERED POLICY MODEL

This section summarizes and addresses the major points of critical analysis of layered models, as well as reviewing the critical differences of other layered policy models when compared to the SMC layered policy model. This section then goes on to discuss why a layered policy model is still a viable approach and why the SMC layered model remains the best approach for policymaking in the current environment.

A. SMC Layered Policy Model Description

As discussed in detail earlier, the SMC layered policy model began by considering the OSI and TCP/IP models that technologists use to conceptualize the hardware and software associated with a network. The SMC model excludes layers that did not directly relate to policy or market concerns, with the layers in the SMC model representing services and service providers, rather than the protocols or protocol implementations.

41. *See* Sicker & Mindel, *supra* note 1, at 18.

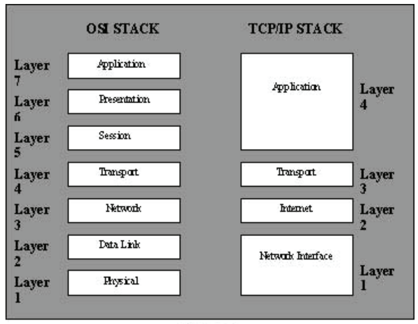

Figure 4

The *Access and Transport layers* represent providers of physical services. The *Application layer* represents providers of application services reliant on underlying Access and Transport services. Lastly, the *Content layer* represents providers reliant on underlying Access, Transport and Applications, including video, music and telephony services.

Critical to this model is the separation of the Access and Transport layers. As noted earlier, the Transport layer represents the "long-haul" or backbone portion of the network that supports large scale movement of data in a fairly competitive market environment. Whereas, the Access layer represents the "last-mile" portion of the network that operates on a much different scale, in a fairly non-competitive market environment, using different technology.

The separation of the Access and Transport layers is critical to a layered policy model since the representative networks operate fundamentally differently in separate markets and under vastly different market conditions. As such, separation of the Access and Transport layers allows for the proper incentives to be introduced, via regulation or economic incentive, to encourage these service providers to interconnect on reasonable terms. Importantly, the separate Application layer distinguishes between provision of a data delivery service (Access or Transport layers) and the applications that use or support the data delivery service. Also critical is that the SMC layered policy model stresses that the Application layer is a highly innovative layer that should be encumbered by minimal regulatory interference to preserve its innovation and open and developmentally accessible nature.

This is the essential framework of the SMC layered policy model. The goal of the model is to create consistency in policy. If used properly, a layered model will be helpful in minimizing or compartmentalizing regulation because it allows policy makers to consider regulation at each layer distinct from others, targeting only the appropriate layer. As such the SMC layered policy model itself does not advocate specific policy positions. But, one may employ various tools within the framework, such as use of market power analysis and use of fines or additional obligations for anticompetitive exertion of market power or violation of interconnection rules.

B. Layered Model Criticisms and Differences

Major points of critical analysis of layered policy models are reviewed here and addressed in relation to the SMC layered policy model. This section groups duplicate and overlapping criticisms together and reviews the assessment of them to more clearly delineate the critical issues with layered policy models and the answers to these criticisms.

Criticism: Faulty assumption of ***undue market power****, given the number of competing providers;*[42] *VoIP will only increase competition*[43]*; "Voice over Internet completely replaces traditional telephone calling;"*[44] ***Facilities-based competition*** *exists;*[45] ***UNE-P*** *is not creating facilities-based competition; Regulation of telecommunications industries is no longer needed;*[46] *Assumption of* ***monopoly power*** *of physical layer providers is incorrect when considering wireless and satellite technology advances and broadband over power line potential;*[47] *The layered model* ***criminalizes competition*** *by punishing those with undue market power;*[48] *Layering (a.k.a. unbundling) will degenerate into simple price regulation;*[49] ***UNE-P causes lack of investment*** *in DSL and the layered model would extend this investment uncertainty to all Internet companies in the Physical layer.*[50]

These criticisms are closely related and the same or overlapping support is used in addressing these points. First, mere numbers of competing providers is only one factor in determining market power or true competition. The statistics do not reveal that there is true competition and an assumption of ILEC market power is not unwarranted. CLECs only provide service over 18.5% of the total lines and only 25.8% of those account for their own local loop facilities (barely over 4% of the total lines), while 74% of their service is provided over

42. *See* NMRC, *supra* note 1, at 1-5.
43. *Id.* at 5.
44. *Id.* at 20.
45. *Id.* at 5.
46. *Id.* at 20.
47. *Id.* at 5.
48. *Id.* at 12.
49. *See* Reed, *supra* note 1, at 2.
50. *Id.*

leased ILEC UNEs or resale of ILEC services.[51]

Although mobile wireless subscriptions are just beginning to slightly outpace land lines,[52] this service is largely duplicative, with customers having both a land line and a mobile subscription and is not indicative of direct competition. Additionally, VoIP only offers service over 1.5% of the total lines.[53] Also, VoIP (as now generally offered) is not a complete replacement for traditional telephony service as the quality of service and reliability are not equivalent, and E911 features are only now being required and adopted. Similarly, the aforementioned rebuts the assertion that facilities-based competition exists in the current market and supports the contention that UNE-P is failing to create facilities-based competition. That said, it should be noted that only the Whitt-MCI model specifies use of UNE-P, as other layered policy models are more generalized frameworks that do not propose specific policy positions. In any case, as the above support illustrates, there is not meaningful facilities-based competition, suggesting that regulation of telecommunications or market opening measures may may still necessary. Further, regulations are often used to promote desirable goals, such as ubiquity of service, public safety, national security, education and other goals that may not be brought about naturally by market mechanisms.[54]

In addition, an assumption of monopoly power is not improper when considering the impact of advances in wireless, satellite technology, and broadband over power line on the telecommunications sector. Although there are advances in these emerging technologies, they have yet to translate into competition to voice service providers. Additionally, the support cited in the preceding paragraph on undue market power, shows an assumption of monopoly power in general (or at least great concentration of market power) in the access market is not an unfair assumption.

Layered policy models do not criminalize competition by punishing those with "undue market power." Although the Whitt-MCI model relies strongly on market power analysis, the SMC model merely views this as one tool that may be utilized within a layered framework and would only use this in the case of an anti-competitive exercise of market

51. FCC, Federal Communications Commission Release Data On High-Speed Internet Access Services, at 4-6 (December 2004), *available at* http://www.fcc.gov/Bureaus/Common_Carrier/Reports/FCC-tate_Link/IAD/hspd1204.pdf.

52. *Id.*

53. Rhonda Ascierto, *E911 Ruling May Raise VoIP Prices*, COMPUTER BUSINESS REVIEW ONLINE (May 23, 2005), *at* http://www.cbronline.com/article_news.asp?guid=1C0594D0-8FEF-4FC6-9A8B-061208534601.

54. *See* Sicker, *supra* note 23, *Further Defining a Layered Model for Telecommunications Policy*, at 2.

power, not mere possession of "undue" market power.[55] For the same reasons, the SMC layered policy model would not devolve into simple price regulation.

Criticism: The layered model puts a ban on vertical integration / effects structural separation/ erects barriers between layers;[56] Regulators "could stifle innovation in cross-layer network technologies . . . [and] may preclude realizing economies of scale and scope across the unbundled interfaces;"[57] The layered model encumbers the transport layer, especially the last mile with regulation;[58] The Whitt-MCI model "places no value on economies of scope and vertical integration . . . leav[ing] the most costly portion of communications – building and operating the transport network under heavy regulation."[59]

While the Whitt-MCI paper advocates maintaining rules that prevent ILECs from "closing interfaces between layers" or stifling higher layer competition,[60] even it does not imply that there should be a ban on vertical integration, nor does it (or any other layered policy model) effect structural separation. The SMC and other layered policy models also do not propose such a ban or imply structural separation, and they only consider control of multiple layers a factor in triggering additional obligations (such as pricing conditions) *if* market power is exerted in an exclusionary and anticompetitive manner. Furthermore, in contrast to erecting barriers between layers, using a layered policy model allows regulation to be readily compartmentalized and minimized by targeting only the appropriate layer.[61] For these reasons, a layered policy may not stifle innovation in cross-layer network technologies or preclude realizing economies of scale and scope across the unbundled interfaces.

Only the Whitt-MCI layered policy model extends UNE-type obligations to wire line broadband. Using other layered policy models may well result in removal, rather than extension of current regulation in

55. *See id.* at 20 (stating that, "while similar policy will be applied to all service providers, those determined as having significant market power will have additional obligations. When a player is determined to have significant market power, a pricing condition will be invoked. This condition will vary depending on power exerted; whether the player controls multiple layers or significantly controls a particular layer. For example, many cable and LECs would be viewed as significantly controlling the access layer. Other players, such as AOL/TW, would be viewed as operating in multiple layers.").

56. *See* NMRC, *supra* note 1, at 6, 12, 16, 23, 27-29.

57. Reed, *supra* note 1, at 2, 11.

58. *See* NMRC, *supra* note 1, at 5.

59. *Id.* at 21.

60. *See* Whitt, *supra* note 1, at 653.

61. *See* Sicker, *Further Defining a Layered Model for Telecommunications Policy*, *supra* note 23, at 9.

that similar services, regardless of the delivering infrastructure, would be viewed in a similar manner. Thus, cable, wireless and satellite broadband providers shall be considered competitors to DSL providers, possibly allowing policymakers to see sufficient competition within that layer. The same argument applies to the assertion that transport layer, especially the last mile, is encumbered by regulation by a layered policy model. This argument is true for the Whitt-MCI model, but not for other layered policy models.

While we agree that the Whitt-MCI model proposes unduly heavy regulation of the physical access layer and that physical network providers need a return on investment, it should not come at the expense of stifling competition in higher layers, *i.e.* facilities owners must not be allowed to shut out non-affiliated applications providers.[62]

Criticism: "A layered policy model places too much control in regulators to "beneficently intervene" in the market and relies too heavily on antitrust law."[63]

Although it is desirable to rely on market forces to provide optimal innovation and competitive consumer pricing and benefits, current market conditions (market consolidation, lack of reasonable interconnection agreements, and lack of facilities-based competition) do not allow for this. Furthermore, this criticism is applicable only to the Whitt-MCI model. Again, the SMC layered policy model mentions market power evaluation merely as a tool that may be employed within a layered framework.[64] Moreover the SMC model does not advocate threat of divestiture, as it is not likely to create the desired response, especially in any meaningful timeline. Rather, improved capability to monitor and fine those that violate pricing or interconnection rules is crucial.[65]

Criticism: The model is a "gross simplification" of Internet elements with no appropriate reference to how those layers interact or relate;[66] *A superior analytical tool for network engineers is not good for network regulators;*[67] *A layered model centered around the Internet does not*

62. *See* Sicker, *The Internet Connection Conundrum*, *supra* note 3, at 14.

63. *See* NMRC, *supra* note 1, at 8.

64. *See* Sicker, *Further Defining a Layered Model for Telecommunications Policy, supra* note 23, at 11, 20.

65. *Id.*

66. *See* NMRC, *supra* note 1, at 11.

67. NMRC, *supra* note 1, at 8. We note that McClure specifically reviews the Whitt-MCI layered model, and in the narrower context of use for Internet Public Policy only.

capture all telecommunications.[68]

First, the basis of the SMC layered policy model is not the Internet, but the TCP/IP model –these are not equivalent. Furthermore, the TCP/IP model is used only as a starting point. The layers in the SMC layered policy model are representative of providers of services, not protocols or protocol implementations of TCP/IP.

Inherent in the above explanation is that the SMC model is not the same model that network engineers use. More importantly, development of the SMC model extensively considered what layers relate to policy issues, real market conditions, and what layers are associated with relevant network devices and services.[69] Work on the SMC model identified no less than seven relationships between the layers and described and analyzed them in great detail.[70] In addition, numerous other considerations were made in developing the SMC model.[71] The criticism that a layered model centered around the Internet does not capture all telecommunications today is directly focused at the Werbach layered policy model, which advocates "reformulat[ing] communications policy with the Internet at the center . . . build[ing] our laws around the Internet, not the other way around."[72] In summary, the SMC layered policy model is not Internet focused, but used the TCP/IP model as a starting point for its development.

Criticism: Loss of technical neutrality in regulation;[73] *The need for technological neutrality should be explicitly added to the model.*[74]

Use of a layered policy model will bring technical neutrality to regulatory analysis by providing a framework where markets and competition are evaluated in a technologically neutral manner.[75] Thus providing consistency in that similar services in equivalent layers are viewed in a similar manner,[76] rather than viewing similar services

68. Marcus, *supra* note 1, at 1 (citing Kevin Werbach, *A Layered Model for Internet Policy*, 1 J. ON TELECOMM. & HIGH TECH. L. at 38, 58 (2002)).

69. *See* Sicker, *supra* note 3, *The Internet Connection Conundrum* at 27-48.

70. *See* Sicker, *Further Defining a Layered Model for Telecommunications Policy*, *supra* note 23, at 17-18.

71. *See* Sicker & Mindel, *supra* note 1, at 81-83.

72. Werbach, *supra* note 1, at 38, 58.

73. *See* Reed, *supra* note 1, at 2.

74. J. Scott Marcus & Douglas C. Sicker, *Layers Revisited* (Sept. 25, 2005) (unpublished manuscript, presented at Telecommunications Policy Research Conference), *available at* http://web.si.umich.edu/tprc/papers/2005/492/Layers%20Revisited%20v0.4.pdf.

75. *See* Sicker & Mindel, *supra* note 1, at 5.

76. *See* Sicker, *supra* note 23, *Further Defining a Layered Model for Telecommunications Policy*, at 9.

differently because of their legacy classifications.

C. A Layered Policy Model Remains Relevant

The SMC layered policy model is intended as a tool for examining communications policy issues and to move policy decisions to technical neutrality, and therefore more consistent treatment of providers of similar services. This is achieved by considering regulatory action based on providers offering similar services, rather than on which underlying infrastructure carries the service. An effect of employing the SMC layered policy model is that it minimizes regulation. In this way, the highly innovative application layer could retain its rate of innovation by avoiding unintentional regulation. In the same manner, unnecessary or unintentional regulation of the competitive market of the Transport layer is avoided by separating it from the non-competitive, high sunk-costs market of the Access layer. And any regulation of the Transport layer would not unintentionally include the Access layer since they are considered separately within the SMC model as they are separate markets that operate fundamentally differently and exist under vastly different market conditions.

CONCLUSION: THE INEVITABLE LAYERS OF A REGULATORY FRAMEWORK

While the critics of the layered models are mostly accurate in their assessments, they are focused on only one of the models (the Whitt-MCI model) and fail to fully consider the other work in the area. Specifically, the SMC layered model withstands the criticisms leveled at the Whitt-MCI paper.

It remains to be seen just what direction the US will take in revising the 1996 Telecom Act, but it appears likely that steps will soon be taken to revise it. And while the debate continues concerning the value of a layered model, it is difficult not to believe that distinctions (and thus layers) will exist in what ever regulatory framework that is adopted. For example, it seems likely that the network that develops will separate the physical facilities from the applications and content that travel over them.

As we continue to move to a world where transport networks converge to offer broadband IP access, we will see these various networks supporting the same applications and content. As such, the network model will be one of access and transport networks at lower layers, with the applications and content that ride on these networks in higher layers. Even a policy model that ignores the difference between transport, applications and content will find itself faced with addressing these distinctions should a market abuse issue arise. Such analysis might consider the abuse of dominance in one market (say access networks) or the tying of a transport network with an application or content. In this way, the final analysis will indeed be about layers, regardless of whether the policy model labels them.