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A PROPOSED DEVICE ATTACHMENT STATUTE FOR CONVERGED NETWORKS

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Interconnection of user-side devices and applications to networks has long been a contentious issue, compounded by the emergence of converged broadband networks. Doctors Jordan and Shaffer offer a "unified" draft statute to ensure users the right to connect devices and applications of their choice while ensuring providers the right to reasonable network management. Analyzing current attachment rules for telephony, cable, MVPDs, mobile services, and the Internet, they propose a single set of rules for operating in a converged broadband network environment. They acknowledge that there are difficult issues involved and try to apply a balancing of interests to resolve them.

INTRODUCTION

In the United States, a user's legal ability to attach and control a device to a network depends on whether the device is attached to a telephone, video device, cellular network, or the Internet. In telephone networks, for instance, Part 68 regulations provide strong assurance that users may attach and control non-harmful devices of their choice.[1] In multichannel video programming distributor (MVPD) networks, CableCARD regulations provide similar assurance.[2] The rules change when it comes to broadband access service. The Federal Communications Commission (FCC) recently adopted an Open Internet Order meant to provide some assurance that fixed broadband Internet users may attach non-harmful devices of their choice. However, the regulations do not define "harmful," nor do they clearly specify which functionality of user devices the service provider may control.[3] An entirely different set of rules applies to cellular networks. These regulations allow service providers to exercise great latitude over which devices a user attaches to the network, as well

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[1] Federal Communications Commission, *FCC 68-661: Use of the Carterfone Device in Message Toll Service (Carterfone Order)*, Federal Communications Commission Reports 2nd Series 13 (1968), 420, accessed Sept. 26, 2011, http://www.uiowa.edu/~cyberlaw/FCCOps/1968/13F2-420.html.
[2] Federal Communications Commission, *FCC 98-116: Implementation of Section 304 of the Telecommunications Act of 1996: Commercial Availability of Navigation Devices, Report and Order (CableCARD Order)*, Federal Communications Commission Record 13(21) (1998), 14775, accessed Sept. 26, 2011, http://transition.fcc.gov/Bureaus/Cable/Orders/1998/fcc98116.txt.
[3] Federal Communications Commission, *FCC 10-201: Preserving the Open Internet; Broadband Industry Practices, Report and Order (Open Internet Order)*, Federal Communications Commission Record 25(21) (2010), 17905, 14775, accessed Sept. 26, 2011, http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-10-201A1.pdf.

as allowing them to control a wide range of functionalities of those devices. In the United States, users obtain nearly all of their wireless devices from their cellular provider.

However, from the end-user perspective, the act of accessing a network is becoming increasingly similar, whether using a personal computer (PC), smartphone, or set-top box to do so. Vertical silo regulation of device attachment and control is incompatible with this evolving user view. Although vertical regulation is often criticized, recent actions taken by the FCC have maintained and even strengthened these artificial silos with respect to device attachment. The FCC's Open Internet Order continues to classify broadband Internet access as an information service, rather than as a more tightly regulated telecommunications service. As a result, even services and providers that directly compete with one another may be treated differently under current rules.

This article explores the issues that must be resolved in order to create unified regulation of device attachment in converged communication networks. It is apparent that it is not sufficient to merely state an "any device" rule without substantial development of further statutes or regulations that detail what this means. The article posits that these issues include demarcation of the connection point between a provider's network and a user's network, delineation of reasonable network management of various user devices, subsidization of user devices, and content protection. Furthermore, it explains that reasonable network management in this context requires identification of not only which functions are reasonable but also in which devices. Thus issues of discrimination and harm also arise. For each such issue, this article also presents an example of statutory language that could be used to resolve the issue.

The proposed statutes ensure users the right to connect devices of their choice while simultaneously ensuring network providers the right to maintain reasonable network management. It is consistent with current user and provider rights on telephone networks, and strengthens user rights on cable and satellite networks and on cellular networks. It can be applied to residential networks attached through cable and digital subscriber line (DSL) modems, Internet residential gateways, set-top boxes, and smartphones, and it addresses which protocols and devices should be controlled by users and which should be controlled by providers. The proposed statute eliminates separate device attachment rules for telephone, cable television, satellite television and cellular networks, and the Internet.

THE CONVERGED ENVIRONMENT

Convergence

During the past 25 years, most telephone networks have greatly expanded their capacity by deploying fiber. The backbone infrastructure now converts analog signals to digital and carries them as Voice over Internet Protocol (VoIP). With this extra capacity and capability, most telephone networks now offer not only telephone service, but also Internet and video access. DSL modems delivering broadband traffic use the Internet Protocol (IP) over the entire path, from source to

destination. In recent years, some telephone networks have also begun offering video service known as Internet Protocol Television (IPTV). One such network, AT&T's U-verse, is available to more than 23 million homes.[4] Verizon's FiOS, another IP-based network, claims more than 3 million subscribers.[5] Telephone networks are thus migrating toward an integrated IP architecture to support telephone calls, Internet access, and video.

Most cable television networks have also deployed fiber and have transitioned from analog to digital transmission in the network backbone. Similarly, satellite networks have increased capacity by adding infrastructure and using more efficient transmission methods. Consequently, cable and satellite networks routinely offer not only video service, but also Internet access and telephone service. Industry analysts expect to see video transmission migrate to an IPTV architecture as well. Broadband traffic on cable networks, carried at the endpoints via cable modems, uses IP over the entire path from source to destination. Telephone service over cable networks uses a VoIP architecture. Cable and satellite networks are, ultimately, migrating toward an integrated IP architecture to support telephone calls, broadband access, and video.

Cellular networks have similarly transitioned from analog to digital transmission, and now offer not only telephone service but also Internet access and often video programming. With the upgrade to fourth generation (4G) technology in the next few years, it is expected that carriers will migrate voice traffic onto a VoIP architecture.[6] When smartphones access the Internet, they already rely on an IP architecture. Finally, some cellular carriers now offer video services, Verizon's VCAST for example. Soon, this video content is also likely to be delivered over an IPTV architecture.

Finally, the Internet was designed to offer data services such as file transfer and e-mail. However, with the increased popularity of gaming and voice and video chat applications, the Internet is now in the process of transitioning toward an architecture that can more efficiently support real-time applications such as telephone calls and video conferencing.

Telephone, video, cellular networks, and the Internet are thus merging. Economic and regulatory forces have reinforced technology trends. A flurry of mergers between communications companies has brought together content providers, broadcasters, cable networks, local and long distance telephone networks, cellular networks, and Internet Service Providers (ISPs). Different portions of such converged networks use different access technologies, including telephone wiring, coaxial cable, fiber, and wireless transmission.

Not only are the networks themselves converging, but the range of applications offered on each are also converging. Regardless of the physical medium, these networks use the standardized IP

[4] AT&T, "2009 Annual Report: AT&T U-verse," 3, accessed June 16, 2011, http://www.att.com/gen/investor-relations?pid=17388.
[5] Karl Bode, "Verizon: 3.1 Million FiOS Customers," Broadband DSLReports.com, July 27, 2009, accessed June 16, 2011, http://www.dslreports.com/shownews/Verizon-31-Million-FiOS-Customers-103626.
[6] Motorola, "Beyond Mobile Broadband," accessed June 16, 2011, http://business.motorola.com/experiencelte/lte-experience.html.

protocol to support telephone service, streaming video, video conferencing, gaming, e-mail, web browsing, and file transfer.

These converging communications networks are steadily progressing toward supporting a wide variety of heterogeneous devices. Today, a typical residential network may connect a modem, a wireless router, computers, printers, televisions, music systems, network attached storage, wireless adapters, and set-top boxes. Cell phone networks now enable smartphones, tablets, e-readers, and navigation devices to access the Internet. A wider variety of Internet-connected devices is expected, and the Internet of things is the subject of many studies. Communication transactions that previously required multiple gadgets – making phone calls, listening to music, sending e-mail, browsing the web, watching video, and taking pictures – may all now be performed on a single handheld device.

Regulation of Common Devices

Rules governing device attachment can greatly affect the development of a competitive market. This section briefly discusses three impacted devices: residential gateways, set-top boxes, and smartphones. Increasingly, homeowners are establishing "residential gateways" – allowing them to connect a wide variety of devices to the Internet – with connectivity provided by an ISP. However, an ISP sometimes mandates use of its own residential gateway, precluding users from attaching routers of their choice. In addition, the ISP maintains control over nearly all protocols used in the gateway, which may deprive subscribers of the use and control of certain applications.

Cable and satellite television subscribers typically access these services through a set-top box. In some cases, the consumer must lease the box from the provider. In other cases, the consumer may elect to purchase a set-top box offered by a consumer electronics company. However, it may not provide access to all video content. The set-top box supplied by the video provider, on the other hand, may limit devices that a consumer connects to the network and use proprietary protocols to access certain information streams. As a result, this may disable the functionality of other user-chosen devices, such as video navigation.

Smartphones used on cellular networks present an even greater challenge to open networks. A cellular provider often exercises control over the devices used on its network through a combination of terms of service and device pricing. Because the provider reserves the right to control nearly all communication protocols on the device, it is not uncommon for providers to lock devices to their own networks and to cripple handset functionality.

The focus of this article is on device attachment and control in converged networks. Convergence will rend vertical regulation of devices on each network infeasible, as users cease to distinguish between the types of networks to which they connect. If a user watches video on a mobile device using a cell phone network, would this service be regulated in the United States under Title II of the Communications Act as a communications service, under Title VI as a video service, or under Title I as a broadband service? If the user then walks inside a residence and switches to a Wi-Fi network,

does the service classification change? Increasingly, users will not view "telephone service," "video service," and "broadband service" as three distinct services.

Users also expect to connect a wide variety of devices, and to use these devices without unreasonable interference from a network access provider. Increasingly, users are rejecting limitations on wireless devices when these same limitations are unacceptable in the context of their wired devices. For example, it is unthinkable that the Comcast or Cox cable companies would bar subscribers from using a particular PC. Yet AT&T and Verizon dictate which devices may access their wireless networks.

Literature Review

Substantial research literature highlights the need for a unified regulatory approach to converged networks in general. Nuechterlein and Weiser explain that the telecommunications market can't function effectively without a converged regulatory policy that treats like services alike, regardless of what physical infrastructure is used to provide them.[7] They urge policymakers to place heavy regulation on the layers of each network that encompass wholesale transmission services, and to analyze petitions for vertical integration by assessing the potential for that company to leverage its market power to the detriment of competitors at higher levels. In the absence of such a converged policy, Bar and Sandvig explain that vertical integration means that companies "increasingly interact across regulatory boundaries," broadening the possibility that industry players will profit by exploiting price differences in similar markets.[8] They propose dropping current regulatory structures that approach regulation based on the physical conduit and who owns it, and conclude that a more appropriate telecommunications policy should focus on the software configuration that defines the architecture of each platform in this converged environment. Schejter argues that definitions should be developed at the "highest normative level," with regulators then analyzing and determining how to apply them.[9]

Despite fervent discussion of the challenges of convergence, minimal academic literature addresses device attachment and control in converged networks. Wu focuses on whether subscribers should be able to attach wireless devices of their choice, and argues for an extension of the FCC's *Carterfone* rules to wireless networks – including prohibiting carriers from locking devices and allowing users to attach compatible and non-harmful devices.[10] To make this a reality, Wu proposes that the industry or the FCC define a basic air interface for wireless devices. He also argues for the application of net

[7] Jonathan Nuechterlein and Philip Weiser, *Digital Crossroads: American Telecommunications Policy in the Internet Age* (Cambridge, Mass.: MIT Press, 2005).
[8] Francois Bar and Christian Sandvig, "U.S. Communications Policy after Convergence," *Media, Culture & Society* 30, no. 4 (2008): 544.
[9] Amit Schejter, "'From All My Teachers I Have Grown Wise, and From My Students More than Anyone Else': What Lessons Can the US Learn from Broadband Policies in Europe?" *The International Communication Gazette* 71, no. 5 (2009): 429-446.
[10] Timothy Wu, "Wireless Carterfone," *International Journal of Communication* 1 (2007): 389-426.

neutrality to wireless networks,[11] and asserts that carriers should meter and charge for bandwidth usage rather than block particular applications. Wu advocates requiring wireless carriers to disclose practices such as locking phones, disabling protocols or applications, and limiting bandwidth. Finally, he recommends that carriers and equipment manufacturers work toward standardization of application development platforms. In response, Hahn, Litan, and Singer claim that attachment of devices and Quality-of-Service (QoS) are separate issues.[12] Having previously opposed net neutrality as a method to regulate QoS,[13] in this paper they contest many of Wu's proposals. First, they argue that there is sufficient wireless competition to avoid market failure and that innovation in wireless devices and applications is thriving. Next they argue that the results of an economic analysis show that the benefits of device subsidies, device exclusivity, and limits on devices and on applications outweigh the costs of each.

Methodology

The remainder of this article applies traditional policy analysis techniques,[14] with the goal of identifying the issues that must be resolved in order to create unified regulation of device attachment in converged communication networks. Table 1 below will be used throughout the article to identify and track these issues, which are listed in the left column.

[11] Federal Communications Commission, *FCC 05-151, Appropriate Framework for Broadband Access to the Internet over Wireline Facilities et al., Policy Statement (Internet Policy Statement)*, Federal Communications Commission Record 20(17) (2005), 14986, accessed Sept. 26, 2011, http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-05-151A1.pdf.
[12] Robert Hahn, Robert Litan, and Hal Singer, "The Economics of 'Wireless Net Neutrality," *Journal of Competition Law & Economics* 3, no. 3 (2007): 399-451.
[13] Robert Hahn and Robert Litan, "The Myth of Network Neutrality and What We Should Do About It," *International Journal of Communication* 1 (2007): 427-460.
[14] For an explanation of these methods, see Eugene Bardach, *A Practical Guide for Policy Analysis* (Washington: CQ Press, 2005).

Issue	Telephone	Cable MVPD	Satellite MVPD	Cellular	Fixed Internet access	Mobile Internet access	Proposed Statute
Demarcation point required	Yes	Yes	No	No	No	No	Yes
Harm defined	Yes	No	No	Partially	No	Partially	Yes
Any device rule	Yes	Yes	No	No	Yes	No	Yes
Discrimination prohibited	Yes	Partially	No	Yes	Yes	No	Yes
Interconnect.	No	No	No	No	No	No	Yes
Subsidies	No	No	No	No	No	No	Yes
Gateway defined	No	Partially	No	No	No	No	Yes
Control point defined	Yes	Partially	No	No	No	No	Yes
Reasonable network management defined	Yes	No	No	No	Partially	Partially	Yes
Content protection	No	Partially	Partially	No	No	No	Yes

Table 1: Comparison of Legal Approaches

There is a great deal of latitude in how to resolve each issue. Each row of Table 1 shows whether each current type of vertical regulation addresses the corresponding issue. For issues that are addressed by regulation of one or more types of networks, this article asks if current regulations can be merged and extended to apply effectively to converged networks. For issues in which there is no current regulation, current regulations are mutually contradictory, or current regulations cannot be extended to apply effectively to converged networks, this article proposes statutory language based on fundamental user rights and provider rights.

PRINCIPLES

As previously noted, it will soon become impossible to maintain different and conflicting communications law provisions regarding device attachment – as telephone, video, cellular networks, and the Internet converge. Sound policy must be grounded in principles. To guide development of a unified device attachment statute, this section proposes two sets of rights – one that should apply to users of communications networks, and another that should apply to providers

of communications services.[15] While the principles detailed in this section do not negate the needs of industry stakeholders, they place equal emphasis on the rights of communications users. The following principles are modeled, either loosely or closely, on notions of Internet governance that exist in other contexts.

The following user rights have been commonly recognized:

> **U1:** Users of communications services are entitled to choose a communications provider in a competitive marketplace.
>
> **U2:** Users of communications services are entitled to connect any legal device to a communications network, so long as that device does not cause harm to the network.
>
> **U3:** Users of communications services are entitled to run applications of their choice on their devices.
>
> **U4:** Users of communications services are entitled to transparency in terms of billing, traffic management, device restrictions, and all other aspects of their communications services.

In 2005, in the early days of the net neutrality debate, the FCC issued a set of principles that it proposed should apply to consumers and providers of telecommunications for Internet access.[16] Right U1 is modeled on the FCC's right of consumers to "competition among network providers, application and service providers, and content providers." However, the reference to application, service, and content providers is omitted since that is outside the scope of this article. Right U2 is modeled on the FCC's proposed right of consumers to "connect their choice of legal devices that do not harm the network." Right U3 is modeled on the FCC's right of consumers to "run applications and use services of their choice." Right U4 is modeled on transparency principles later proposed by the FCC and multiple stakeholders.

The following communication provider rights have been commonly recognized:

> **P1:** Communication providers are entitled to charge for communications services provided to their subscribers.
>
> **P2:** Communication providers are entitled to the use of reasonable network management.
>
> **P3:** Communication providers are entitled to forbearance from regulations that are unnecessary for ensuring user rights.

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[15] While the focus of this article is exclusively on the relationship between devices and network carriers, the owners of operating systems – as opposed to carriers – are responsible for imposing some device restrictions. However, this study examines only actions taken by communications providers. Therefore this article does not address device restrictions imposed by operating systems or content providers.

[16] Federal Communications Commission, *FCC 05-151, Appropriate Framework for Broadband Access to the Internet over Wireline Facilities et al., Policy Statement (Internet Policy Statement).*

Right P1 is an original statement, but it represents a basic tenet of capitalism; it is intended to make it clear that user rights are limited by the services purchased from their communication providers. Right P2 is modeled on FCC's net neutrality rules, which make all user rights subject to reasonable network management.[17] (Listing reasonable network management as a communication provider right is more straightforward than incorporating it into each user right.) Right P3 reflects a provision of communications law specifying the conditions under which communications regulations should be exempted; exemptions are granted when a marketplace is viewed as sufficiently competitive.

RECLASSIFICATION

The Challenge of Definitions for Converged Networks

As the ultimate goal of this article is to craft a statute for device attachment in converged networks, the scope of "converged networks" must first be defined and delineated. The differing terms used within the context of various regulatory silos complicates this task, however. Title II of the Communications Act of 1934 applies to *common carriers*, defined recursively as "any person engaged as a common carrier for hire in… communications by wire or radio," excepting radio broadcasting. However, much of Title II concerns only providers of *telecommunications service*, defined as "the offering of telecommunications for a fee directly to the public…" In turn, *telecommunications* is defined as "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." Services over telecommunication networks that are not classified as telecommunications services are often classified as *information services*, defined as "the offering of a capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing, or making available information via telecommunications."

The Telecommunications Act of 1996 placed telecommunications services, but not information services, under Title II of the 1934 Act. As a result, Part 68 regulations apply only to telecommunications services. In 2002, the FCC ruled that cable modem service is exclusively an information service, not a composite of telecommunications service and information service.[18] In 2005, the FCC similarly ruled that DSL modem service is solely an information service.[19] Both rulings are controversial.

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[17] Federal Communications Commission, *FCC 09-93: Preserving the Open Internet; Broadband Industry Practices, Notice of Proposed Rulemaking (Open Internet NPRM)*, Federal Communications Commission Record 24(16) (2009), 13064, accessed Sept. 26, 2011, http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-09-93A1.pdf.

[18] Federal Communications Commission, *FCC 02-77: Inquiry Concerning High-Speed Access to the Internet Over Cable and Other Facilities et. al., Declaratory Ruling (Cable Modem Ruling)*, Federal Communications Commission Record 17(7) (2002), 4798, accessed Sept. 26, 2011, http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-02-77A1.pdf.

[19] Federal Communications Commission, *FCC 05-150: Appropriate Framework for Broadband Access to the Internet over Wireline Facilities et. al., Report and Order (DSL Order)*, Federal Communications Commission Record 20(17) (2005), 14853, accessed Sept. 26, 2011, http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-05-150A1.pdf.

Title VI of the Communications Act applies to *multichannel video programming distributors*, defined as "a person such as, but not limited to, a cable operator, a multichannel multipoint distribution service, a direct broadcast satellite service, or a television receive-only satellite program distributor, who makes available for purchase by subscribers or customers, multiple channels of video programming." In turn, *cable operator* is defined as "any person… who provides cable service over a cable system…" and *cable service* is defined as "one-way transmission to subscribers of video programming or other programming service…" *Cable system* is defined as "a facility, consisting of a set of closed transmission paths and associated signal generation, reception, and control equipment that is designed to provide cable service…" *Cellular service providers* (formally called providers of commercial mobile services), are defined as "any mobile service that is provided for profit and makes interconnected service available to the public…" *Mobile service* is defined as "a radio communications service carried on between mobile stations… and includes both one-way and two-way radio communication services…" Such providers are subject to only selected portions of Title II.

Finally, in the Open Internet Order, *broadband Internet access service* is defined as "a mass-market retail service by wire or radio that provides the capability to transmit data to and receive data from all or substantially all Internet endpoints… excluding dial-up Internet access service," with further distinctions between fixed and mobile broadband Internet access service depending on whether it serves users primarily using stationary or mobile equipment.

Clearly these multiple definitions will lose their meaning and application as networks converge. A definition of communications services is required that can be effectively applied to converged networks – and that makes sense in current telephone networks, cable and satellite networks, cellular networks, and the Internet.

Layered Internet Architecture

Guidance for creating the required definitions can be provided by examining the architecture of each network. While telephone, cable, cellular networks, and the Internet claim distinct characteristics, each is based on the concept of a modular, layered architecture. Each network device, and the network as a whole, is abstractly composed of a number of vertical layers that provide specific functionalities. A designer of a particular module need only understand the functionality and the interface, not the detailed operation of other interoperating modules. Although designing a component in a modular fashion restricts the design space, the benefits typically outweigh the disadvantages. The OSI (Open Systems Interconnection) model, illustrated in Figure 1 below, is designed to enable various network facilities, each run by a distinct operator, to interconnect. But the design transcends a description that is "purely technical or neutral."[20] In reality, layered architecture is a political-economic notion intended to boost competition within telecommunications markets, and has considerable implications for communications policy.

[20] Jan van Cuilenburg and Pascal Verhoest, "Free and Equal Access: In Search of Policy Models for Converging Communication Systems," *Telecommunications Policy* 22, no. 3 (1998): 171-181.

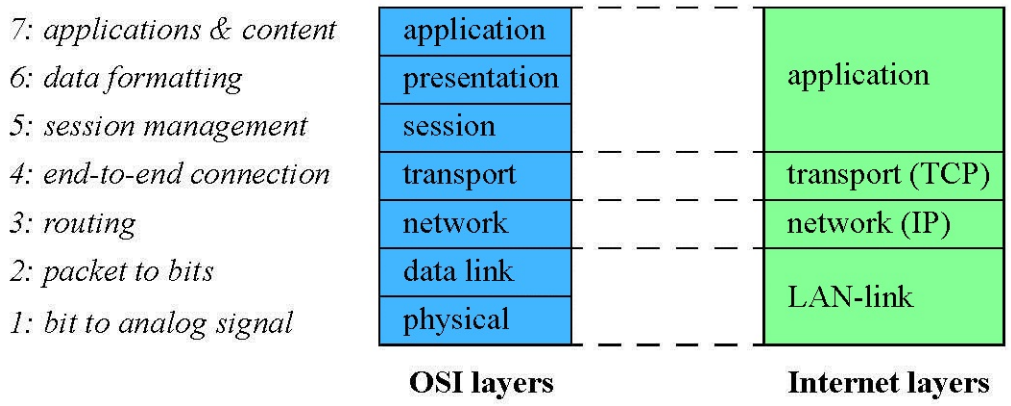

Figure 1: OSI and Internet Layers Models

As an example, two network users – Alice and Bob – may exchange e-mails even if they use different e-mail programs.[21] The e-mail is generated through Alice's e-mail program on her computer (the source) at layer 7. Layer 7 hands the e-mail off to layer 6, which deals with the encoding of the e-mail, HTML for example. Layer 6 then hands the e-mail off to layer 5, which logs onto Bob's mailserver. Layer 4 breaks the e-mail into a sequence of packets, and hands them one-by-one to layer 3. Layer 3 determines the first router on the path from Alice to Bob. Layer 2 decides when each packet can be transmitted, and layer 1 transmits each packet bit-by-bit. When these bits are received by the first router, layer 1 on that router translates the received signal into bits and layer 2 puts the bits back together into a packet, allowing layer 3 to examine the packet header and determine the next router along the path. Subsequent routers act similarly. Finally, layers 1 through 4 on Bob's computer (the destination) assemble the received signal back together into the e-mail, layer 5 retrieves the e-mail from Bob's mailserver, and layers 6 and 7 display the e-mail in Bob's e-mail program.

Statutory Definitions for Converged Networks

Future statutory definitions should be based when possible on both network architecture and previous legal models. Layered regulatory models proposed in the literature have the potential benefit of effectively creating legal definitions that can be applied to converged networks and that are largely backwards-compatible with current legal models.[22] Using a layered model has two strengths. First, the layered model is actually used by engineers in the design of communication

[21] For simplicity, it is assumed that the mail servers reside on the source and destination computers.

[22] For example, see Lawrence Lessig, *The Future of Ideas: The Fate of the Commons in a Connected World* (New York: Random House, 2001); Kevin D. Werbach, "A Layered Model for Internet Policy," *Journal of Telecommunications and High-Tech Law* 1, no. 37 (2002): 37-67; Lawrence Solum and Minn Chung, "The Layers Principle: Internet Architecture and the Law," University of San Diego Public Law Research Paper No. 55, accessed Sept. 26, 2011, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=416263; Rick Whitt, "A Horizontal Leap Forward: Formulating a New Communications Public Policy Framework Based on the Network Layers Model," *Federal Communications Law Journal* 56 (2004): 587-672.

networks and devices. Second, the model can be applied to all four types of networks – telephone, cable and satellite, cellular, and Internet – and thus to converged networks as well.

However, the proposals for layered regulatory models do not agree on which layers should be regulated in which manner. This article proposes that communication services can be defined as the lower layers of the network, and information services as the upper layers of the network. The first question is at which layer the delineation should be made. Although lower layer protocols differ based on the characteristics of the physical connection, converged networks will likely adopt similar protocols at the network layer (OSI layer 3) and above. This does not, however, necessarily indicate that the delineation between communication services and information services should be at the network layer. A further examination of network architecture can point the way. Routers and switches typically contain OSI layers 1-3, while end devices contain all layers. The oft-quoted (and oft-misquoted) Internet end-to-end principle can be interpreted as a suggestion that network functionality should be implemented in OSI layers 1-3 only if it cannot be implemented effectively in higher layers at endpoints. Network architecture thus hints that distinguishing between OSI layers 1-3 and 4-7 can be a powerful tool.

Current legal models in the United States are based on the distinction between *telecommunications services* and *information services*. Telecommunications services entail "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." In terms of layers, this describes the functionality of OSI layers 1-3, which are concerned with transmission and routing of data. In contrast, information services entail "the offering of a capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing, or making available information via telecommunications." In terms of layers, this describes the functionality of ISO layers 4-7, which are concerned with the creation and processing of data.

Both the architectural and legal models thus suggest that differentiating between OSI layers 1-3 and layers 4-7 is a powerful tool. This distinction also creates a relevant economic interpretation. OSI layers 1-3 exhibit a high barrier to entry, while OSI layers 4-7 exhibit a low barrier to entry. The high barrier to entry of infrastructure required to construct the lower layers has resulted in a small number of providers offering service in any particular location. In contrast, the low barrier to entry of applications offered in higher layers has resulted in a competitive market with a large number of application providers.

A pure delineation based on layers 1-3 versus 4-7 is too rigid. Allowance should be made for network management, addressed below. An example of a definition of communication services based on this layered model is:

> COMMUNICATIONS SERVICES — The term "Communications Services" means all services – (A) over a network that uses a public right-of-way; and (B) that reside at or below the network layer or are required to manage the network.

The proposed definition of *communications services* includes services that must be implemented in every portion of the network, including the access network, by including layer 1-3 functions: for example, routing, addressing, and QoS (if used). It also includes services in layers 4-7 that are required for managing the network, since only a subscriber's ISP can provide these functions.

The immediate consequence of this approach, purely on technological grounds, is that the Internet clearly consists of both communications services and information services. The application of the term *communications services* to broadband Internet access service will thus surely imply some type of reclassification. This is intentional, as technological distinctions alone contradict the FCC's decision to classify Internet access solely as an information service.

THE RIGHT TO CHOOSE A PROVIDER

Implementation of the first user right, to choose a communications provider in a competitive marketplace, requires addressing how technological convergence is impacting the types of providers offering communications services, and how the role played by communications providers is evolving as a result of technological convergence.

The first issue that arises is the need for a definition of what constitutes a user device. As discussed above, the variety of devices in various networks is growing, and it is sometimes less than clear whether some devices are the property of the user versus the provider, and whether a user device is for computing, communications, or both. Regulations for different types of networks define user devices with varying levels of specificity. AllVid proposals in particular are struggling with which devices are user property versus provider property.[23] However, Part 68 regulations for telephone networks provide perhaps the most general definition. Part 68 defines what it calls *terminal equipment*. This definition can be easily updated and generalized as follows. First, whereas Part 68 restricts user devices to those on customer premises, converged networks require inclusion of mobile devices. Second, whereas Part 68 is concerned only with devices used for telecommunications or information services, converged networks require inclusion of an updated set of services such as the definition of *communications services* given above. A possible revision of the Part 68 definition is:

> USER DEVICE — The term "User device" means communications equipment located on customer premises or in the possession of the user at the end of a communications link, used to permit the stations involved to accomplish the provision of communications or information services.

Such a definition, however, still relies on delineation between where a network provider's network ends and a user's network begins. The point at which the two networks interconnect is commonly referred to as the *demarcation point*. Determination of the demarcation point is an issue that must be

[23] Federal Communications Commission, *FCC 10-60: Video Device Competition et. al., Notice of Inquiry (AllVid NOI)*, Federal Communications Commission Record 25(5) (2010), 4275, accessed Sept. 26, 2011, http://fjallfoss.fcc.gov/edocs_public/attachmatch/FCC-10-60A1_Rcd.pdf.

resolved to implement an "any device" rule. As illustrated in the first row of Table 1 above, the demarcation point is well-established in telephone networks, but not in other types of networks. Part 68 regulations require a standardized connection between the user's residential telephone wiring and the common carrier's telephone network. The demarcation point establishes the geographical point of the interconnection between the communication provider's network and customer premises wiring. Cable and satellite networks rely on the presence of a junction box and often a set-top box, but no formal demarcation point is defined. It remains unclear if the cable or satellite service provider facilities interconnect with the user's network at the junction box or the set-top box. Proposed AllVid regulations for MVPDs would seem to place the demarcation point on the user's side of the set-top box or adapter, thus placing the set-top box or adapter in the service provider's network.[24] Broadband Internet access also relies on the presence of a junction box and a modem or gateway, but again no formal demarcation point is defined other than that in the underlying telephone or cable network. It also remains unclear if the Internet service provider facilities interconnect with the user's network at the junction box or the modem or gateway, or at the underlying telephone or cable network demarcation point. In cellular networks the air interface essentially serves as a demarcation point, but regulations neglect to formally define a demarcation point and many cellular providers claim wireless devices are part of their network.

A standardized demarcation point that can be applied to all of these networks is necessary. The Part 68 definition of a demarcation point can provide this definition by eliminating the current Part 68 restriction to wireline, replacing the older term *telecommunications services* with a new definition of *communications services*, and explicitly including both wired and wireless user terminal equipment. A possible revision of the Part 68 definition is:

> DEMARCATION POINT — The term "Demarcation point" means the point of demarcation and/or interconnection between the communications facilities of a provider of communications, and wired or wireless user devices, or protective apparatus or wiring at a subscriber's premises.

The requirement that telephone common carriers establish a demarcation point using a standardized interface has accomplished two feats. First, it denotes responsibility for the maintenance of physical facilities; users are responsible for all wiring on their side of the demarcation point. Second, when multiple communications providers compete to serve a residence, the presence of a demarcation point allows a simple way for a user to switch from one communications provider to another. If a similar approach is applied to all communications providers, then the right to choose a provider can be ensured. Part 68 regulations for telephone networks can again be used as a useful starting point. These regulations require a telecommunications service provider to create a demarcation point near where the wiring crosses a property line, and to place a standardized wire or jack at this demarcation point. This requirement can be easily updated and generalized as follows. First, as with the definition of user devices above, mobile devices must be included. Second, as above, the Part 68 restriction to wireline should be eliminated and an updated set of services such as the definition of *communications*

[24] Ibid.

services given above should be included. Third, the interface at the demarcation point should be generalized. A possible revision of the Part 68 definition is:

> REQUIRED DEMARCATION POINT — A communications provider shall establish a demarcation point at either the closest practicable point to where the wiring crosses a property line, the closest practicable point to where the wiring enters a multiunit building or buildings, or the point at which a communications link terminates at a user device. The reasonable and nondiscriminatory standard operating practices of the provider of communications services shall determine which shall apply. Facilities of communications providers at, or constituting, the demarcation point shall consist of an interface conforming to the technical criteria published by a recognized national or international standards body.

The use of the property line for single unit buildings or the closest practicable point for multiunit buildings is used in Part 68. The inclusion of "the point at which a communications link terminates at a user device" can be used to address mobile devices, since the relevant property line is unclear. The requirement of a standardized "interface" rather than a "wire or jack," with standardization to be determined by any recognized standards body, can be used to generalize the interface.

This updated requirement for communications providers to use a standardized interface at the demarcation point can efficiently and effectively implement user right U1. This approach can be applied to telephone networks, for which Part 68 applies, but also to cable and satellite networks, wireless networks, and Internet access.

THE RIGHT TO ATTACH DEVICES

Implementation of the second user right, to connect any legal device to a communications network so long as that device does not cause harm to the network, requires addressing how technological convergence is impacting the types of devices that users routinely attach to communications networks, and which new types of services users are subscribing to as a result of technological convergence.

As illustrated in the third row of Table 1, statutes and/or regulations implement some type of "any device" rule for telephone, cable, and fixed broadband Internet networks. In telephone networks this right is ensconced in Title II of the Communications Act and in Part 68. In cable MVPD networks, CableCARD provides a similar right, but proposed AllVid regulations would allow a provider to require the use of a proprietary adapter. Fixed broadband Internet access providers are required to allow users to attach non-harmful devices, but harm is not defined. Cellular and satellite providers are not subject to any requirements.

Unification of these legal approaches and inclusion of mobile broadband Internet networks and cellular networks is required. There would seem to be three essential elements: a definition of a *demarcation point*, a definition of *harm*, and application of the rule. There are many pieces of current

law that can provide guidance, including Part 68 regulations and section 202 and 251 of the Communications Act. The following subsections discuss the issues involved and apply current law when possible.

Defining Harm and Applying the Any Device Rule

One issue that must be confronted here is the definition of *harm*. As illustrated in the second row of Table 1, *harm* is currently defined for telephone networks. Part 68 regulations describe harm in terms of electrical hazards, damage to equipment, or degradation of service. This definition is sufficient for wireline networks, but must be broadened to apply to wireless networks. One starting point is the definition of *harmful interference* in 47 C.F.R. 15.3 for radio frequency devices, which includes emissions that obstruct or degrade radio communications services.

These definitions of *harm* and *harmful interference* can be combined to address both wireline and wireless devices. However, one other update is required. Both definitions rely on the term *degradation*. In both wireline and wireless networks, degradation of service can occur through reasonable traffic management, as discussed below. Thus an updated definition of harm should be restricted to *unreasonable degradation*.

A possible merger of the Part 68 and 47 C.F.R. 15.3 definitions with such an updated definition is:

> HARM — The term "Harm" means electrical hazards to the personnel of providers of communications, damage to the equipment of providers of communications, malfunction of the billing equipment of providers of communications, and unreasonable degradation of service to persons other than the user of the subject user device, his calling or called party. Unreasonable degradation includes harmful interference, defined as any emission, radiation or induction that seriously degrades, obstructs, or repeatedly interrupts a radio communication service.

As with earlier proposed definitions, references to "wireline" have been removed, references to *telecommunications* have been replaced with *communications*, and references to *terminal equipment* have been replaced with *user device*.

With *harm* defined, it is now possible to implement an "any device" rule. Although such rules currently exist in telephone, cable, and fixed broadband Internet networks, the implementation in fixed Internet access is under-developed and the implementation in cable MVPD networks is in flux. Fortunately, the implementation in telephone networks again provides a useful starting point. Part 68 states that users maintain the right to use any terminal equipment that does not harm the telephone network. The basic idea can be easily applied to all user devices, rather than just terminal equipment, and to all providers of communications services, rather than just to the public switched telephone network. A possible statement of this right is:

> ANY DEVICE — User devices that do not cause harm may be directly connected to the facilities of the communications provider.

It remains to describe how user devices can be guaranteed not to cause harm. Part 68 gives users two options for ensuring that no harm is caused to telephone networks: to purchase devices that are certified not to cause harm or to insert protective circuitry between the device and the demarcation point. These options make sense for other types of networks, and thus this element of Part 68 regulation can also be applied broadly to all user devices by requiring that *all user devices for communications services* either be approved by an independent body that verifies conformance with standards that prevent harm, or be connected through protective circuitry. Common network devices currently meet this requirement since they almost invariably connect through standardized interfaces. An example of statutory language that implements this approach is:

> CERTIFICATION OF NO HARM — User devices must be certified not to cause harm, or must connect through protective circuitry that is certified to prevent harm. Technical criteria published by a recognized national or international standards body are the presumptively valid technical criteria for the protection of the facilities of the communications provider from harms caused by the connection of user devices.

These adaptations of Part 68 regulations acknowledge today's converged communications environment by updating the definition of *harm* to encompass both wireline and wireless networks. Similarly, the proposed statutory language expands recognized standardization bodies to include organizations associated with multiple platforms, as opposed to the existing code that refers exclusively to the certification body for telephone network devices. For instance, currently CableLabs must certify cable modems, while the Broadband Forum serves as the central organization for developing broadband packet networking specifications. The proposed legal approach thus combines the current device rights provided to telephone network users under Part 68, the new device rights of fixed broadband Internet access service users under the Open Internet Order, and current device rights of cable television users.

Discrimination and Interconnection

The proposed "any device" rule presented in the previous subsection should go a long way toward guaranteeing user right U2, the communications services user's right to connect any legal, non-harmful device to a communications network. However, the goal of any "any device" rule is often to ensure a competitive marketplace for devices, and merely allowing attachment does not suffice. The next two subsections tackle issues of potential discrimination through the offering of devices directly by a network provider.

Section 202 of the Communications Act effectively deals with discrimination by common carriers. The inclusion of the phrase "by any means or device" in the section 202 prohibition on unjust or unreasonable discrimination served as a basis for the *Carterfone* decision, and thus the development of Part 68 regulations.[25] The section already applies to telecommunications services, including cellular voice service. However, as illustrated in the row in Table 1 above labeled "Discrimination

[25] Federal Communications Commission, *FCC 68-661: Use of the Carterfone Device in Message Toll Service (Carterfone Order)*, 420.

prohibited," it does not currently apply to mobile broadband Internet access service, and only selected elements have been applied to fixed broadband Internet access service and cable and satellite networks. Whether section 202 should apply to Internet access has been at the heart of the debate over net neutrality.

The prohibition on unjust or unreasonable discrimination by device should apply to all providers of communications services, as defined above. Exceptions should be made for reasonable network management, and this provision can be subject to forbearance; both are addressed below. Application of section 202(a) to other types of networks merely requires replacing *common carrier* with *provider of communications services*:[26]

> DISCRIMINATION AND PREFERENCES — It shall be unlawful for any provider of communications services to make any unjust or unreasonable discrimination in charges, practices, classifications, regulations, facilities, or services for or in connection with like communications service, directly or indirectly, by any means or device, or to make or give any undue or unreasonable preference or advantage to any particular person, class of persons, or locality, or to subject any particular person, class of persons, or locality to any undue or unreasonable prejudice or disadvantage.

Another issue that should be addressed in an "any device" rule is interconnection of devices. Increasingly, a user may connect a whole residential network to the Internet, rather than simply one or two devices. The issue is whether a user should have similar interconnection rights as providers.

Unfortunately, there is not much guidance here. As illustrated in the row in Table 1 labeled "Interconnection," this issue has not been addressed in a statute or regulation for any type of network. Nevertheless, there is some indication in current law of how this might be addressed. Section 251 of the Communications Act addresses interconnection between common carriers. In particular, section 251(c)(2) addresses interconnection between telecommunications carriers with local exchange carriers. It requires interconnection upon request and at a quality at least equal to that provided by the local exchange carrier to itself. This subsection can be applied to connection of user devices by requiring similar interconnection and quality to a subscriber network. An example of statutory language that implements this approach is:

> INTERCONNECTION — A communications provider shall provide, for the facilities and equipment of any subscriber, interconnection with the communications provider's network – (a) for communications services; (b) that is at least equal in quality to that provided by the communications provider to user devices provided to the subscriber; and (c) on rates, terms, and conditions that are just, reasonable, and nondiscriminatory. A communications provider shall not require any communications or information service based on a subscriber's device.

[26] An exception can be made for Title VI service, until such time as Title VI ceases to exist if and when the Communications Act is rewritten to accommodate converged networks. See for example Scott Jordan, "A Layered Network Approach to Net Neutrality," *International Journal of Communication* 1 (2007): 427-460.

This proposed language addresses all communications services rather than only those provided by telephone exchange service and exchange access. The 251(c)(2)(B) requirement for interconnection at any technically feasible point has been omitted, since the requirement for a standardized demarcation point adequately covers this.

Together, these provisions ensure that devices supplied by a communications provider do not tilt the playing field in user devices and still support user right U2. The last sentence of the proposed interconnection statutory language prohibits communications providers from requiring a service on the basis of a subscriber's device. This provision is not present in section 251. However, such a prohibition is necessary to avoid an end-run around the previous provisions. For example, currently many cellular service providers require users to subscribe to a data plan if they use a smartphone; this provision would allow the user of a smartphone to subscribe to only a voice plan, if desired.

Device and Service Plan Integration

Finally, service plans are sometimes used to entice or require users to select particular devices. These subsidies may threaten a level playing field in devices. Consequently, there should be an additional provision directly addressing device subsidies.

The key question is whether such subsidies entitle the communications provider to particular rights. Unfortunately, there is not much guidance here. As illustrated in the row in Table 1 labeled "Subsidies," this issue has not been addressed in a statute or regulation for any type of network. Conflicting views on this issue arise because of integration between the device and services or content offered by the communications provider. The goals of CableCARD and AllVid can provide some guidance. Section 629 of the Communications Act gives the FCC authority to regulate navigation devices offered by MVPDs. This language directs the FCC to assure the commercial availability of converter boxes, interactive communications equipment, and other equipment used by consumers to access multichannel video programming from vendors not affiliated with any MVPD.

The issue is not unique to MVPD networks. In cellular service contracts, providers commonly charge early termination fees, as well as lock handsets. Some value exists in these arrangements. However, in order to promote commercial availability of devices from vendors not affiliated with communications providers, regulations must limit the use of subsidies, early termination fees, locks, and other methods of integration between user devices and service plans. The following statutory language could be used to provide such safeguards:

> DEVICE SUBSIDIES — (A) A communications provider or an affiliated equipment provider may supply a device to a subscriber through lease and/or purchase. If so, then (i) the communications provider shall offer communications and information services without requiring this device lease and/or purchase, and (ii) the communications provider's charge to a subscriber for such device shall be separately stated and not subsidized by charges for any service offered over the communications provider's network. (B) If a communications provider supplies a device through purchase, then (i) any subsidy shall be disclosed, and (ii) any early termination fee associated with the device shall be no greater than the device

> subsidy, and shall decrease at least linearly over the life of the service contract. (C) A communications provider may charge a service initiation fee and/or an early termination fee associated with providing initial service to the subscriber, provided that any such early termination fee is no greater than the incremental cost of providing initial service minus the set-up fee. (D) When a communications provider supplies a subsidized device to a subscriber, it may restrict use of that device to its own network for the life of the service contract.

Item (A)(ii) in this proposed language is adapted from section 629 of the Communications Act, but has been generalized to apply to all user devices and all communications providers. All other items in the provision are original. Item (A)(i) is required to ensure user right U2. Item (B)(i) for purchased devices mirrors the disclosure requirement (A)(ii) for leased devices. Items (B)(ii) and (C) place limits on early termination fees, based on a belief that there is no justification for these fees beyond ensuring a communication provider's right to recoup device subsidies and other service initiation costs. Item (D) allows a communications provider to lock a device, but only for the purposes of recouping a subsidy and for the life of the service contract.

These provisions would ensure a competitive marketplace not just for set-top boxes, but for all communications devices. For instance, a cellular provider would have to allow a lower monthly rate for subscribers who bring their own devices. The combination of these provisions – the application of section 202 and a portion of section 251 of the Communications Act, the broadening of Part 68 rules, and new language concerning the integration of devices and service plans – can efficiently and effectively guarantee communications service users the right to connect legal non-harmful devices to a communications network.

THE USER RIGHT TO RUN APPLICATIONS AND THE SERVICE PROVIDER RIGHT TO REASONABLE NETWORK MANAGEMENT

The right of users to run applications of their choice on their devices (U3), the right of providers of communications services to charge for communications services provided to their subscribers (P1), and the right of communications service providers to use reasonable network management practices (P2) are often in tension with one another. Implementation of these rights requires addressing which parameters are necessary for a communications provider to control, and how these parameters can be established without violating the rights of users.

Current Legal Approaches and Network Architecture

The issue of network management was minimal in Part 68 regulations because telephone networks had little need to control terminal attachments. However, broadband Internet access providers must exercise significant control over some user devices, such as cable and DSL modems, in order to configure the service. Stating that users have the right to connect non-harmful devices and giving them the unfettered right of control over these devices undermines the ability of many providers to

implement the service. The issue becomes murky, however, as network complexity increases. The question of which devices and functionality MVPDs should control is the central issue in the CableCARD and AllVid proceedings. Control of device functionality is even more contentious in cellular networks. Cellular providers often limit the functionality of wireless devices, claiming that network management requires such measures. However, as Wu pointed out, few device restrictions are necessary to manage the network.[27]

In addition, "terms of service" agreements often allow communications providers to access digital televisions and cable modems "at any time, as determined necessary."[28] These agreements also contain language granting the communications provider the authority to open, update, or access personal computers and other equipment associated with high-speed Internet access services.[29] AT&T's U-verse customers must sign off on terms allowing the company to provide "software upgrades, updates, or supplements," which could "reset" customer equipment "and erase saved preferences and stored content."[30]

Regulations must distinguish between devices and protocols controlled by a service provider, and those controlled by a user. The demarcation point defines where one network ends and the other begins. However, while a service provider must control all devices within its network, it is common practice for a service provider to also control certain protocols of certain devices within a subscriber's network. The need exists for a further architectural and legal distinction addressing control over user devices.

Although users choose their own cable and DSL modems, they do not have the unfettered right to control all aspects of the devices' operation. For instance, the ISP may limit a modem's maximum upload transmission rate to a rate specified by the user's subscription plan. This is accomplished by controlling the operation of certain protocols within the cable or DSL modem. Each such modem consists of two interfaces – one that faces the ISP's network and one that faces the remainder of the user's network. The ISP controls the operation of all protocols operating in layers 1 through 3 on the interface facing the ISP's network. In addition, the ISP controls certain limited elements of protocols operating in layers 4 through 7 on the interface facing the ISP's network, e.g. the blocking of signaling traffic from the user's residential network to the ISP's network, control over IP address assignment to the modem, and operation of network management protocols. By contrast, users control the operation of all protocols operating in the interface facing the remainder of the user's network. Communications providers also partially control cable and satellite television set-top boxes. At the very least, providers control the lower three layers of the interface facing their networks. In addition, providers often control set-top box menus and navigation guides.

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[27] Wu, 389-426.
[28] Comcast, "Comcast Agreement for Residential Services," accessed June 16, 2011, http://www.comcast.com/Corporate/Customers/Policies/SubscriberAgreement.html.
[29] Verizon, "Verizon FiOS TV Terms of Service," accessed June 16, 2011, http://www22.verizon.com/terms/files/FiOS_TV_TOS.pdf.
[30] AT&T, "AT&T U-verse TV and Voice Terms of Service," accessed June 16, 2011, http://www.att.com/u-verse/att-terms-of-service.jsp.

When it comes to smartphones, the cellular provider controls at least the lower three layers of the air interface. The provider governs a subscriber's access to services using either signaling from the provider's network or information stored on a SIM card. However, many cellular providers also cripple the functionality of some devices or limit the applications that a subscriber may run.

This issue of control is tightly connected to users' right to run applications of their choice, as described by right U2 above. Users of computers with fixed broadband Internet access universally expect this right. However, whether smartphone users should be entitled to such a right is intensely debated, as seen in part by the FCC's reluctance to extend it to users of mobile broadband Internet access service. As stated above, this right should apply to all communications services.

In order to ensure these rights, a statute or regulation must define which elements of the network are controlled by the communications provider, versus which elements are controlled by the user. This issue did not arise in telephone networks since it was generally assumed that users would control all devices on their side of the demarcation point. The FCC's Open Internet Order prohibits fixed broadband Internet access service providers from blocking applications, but only prohibits mobile broadband Internet access service providers from blocking applications that compete with the provider's voice or video telephone services unless such blocking is deemed reasonable network management. Therefore, cellular providers can legally restrict devices and some applications used on their networks, providing that they disclose any third-party device and application certification procedures.

Cable television service providers must allow subscribers to use a CableCARD in a set-top box of their choice, limiting their ability to control navigation and other higher layer services. With that said, CableCARD has largely failed to encourage a competitive market for set-top boxes. According to the FCC, part of the reason is that CableCARDs do not allow access to two-way services such as video on demand, and they require users to upgrade set-top boxes often to keep up with advances in the cable television providers' services. In response, the FCC is considering replacing CableCARD with a new regulatory model dubbed AllVid that would establish a standard method for residential video devices to connect to a paid-TV service.[31] AllVid would consolidate all proprietary technology specific to the video service provider into a single device. It would allow a video service provider to require the use of a proprietary adapter capable of performing only limited functions. The allowed functions would include serving as a modem, governing access to services, content protection, and routing. However, an adapter would not be allowed to include navigation functions including programming guides and search functionality. The adapter would either be a small device that attaches to another device, or a gateway that attaches to other devices via an open standard such as Ethernet.

None of these legal models are sufficient to achieve the goals presented above. The Open Internet Order does not provide clear guidance as to which devices and functionalities a service provider may control, and treats fixed and mobile broadband Internet access services differently. CableCARD has

[31] Federal Communications Commission, *FCC 10-60: Video Device Competition et. al., Notice of Inquiry (AllVid NOI)*, 4275.

been ineffective, and the AllVid approach would allow a video service provider to mandate the use of a proprietary adapter, which violates users' rights to attach devices of their choice.

Reasonable Network Management

Since current law provides no model, one must look to the research literature. Although many papers have been written about reasonable network management, most are focused on traffic management practices implemented inside the ISP's network. Here, in contrast, what is required is a definition of reasonable network management that can be applied to practices implemented in user devices. This article proposes an original approach to balancing the right of users to run applications versus the right of service providers to use reasonable network management. As discussed above, in current network technologies, service providers only require control over certain devices and over certain functionalities within those devices. The first issue is which devices a service provider needs to control.

In order to create a unified approach, it is necessary to define a control point separate from the demarcation point. The demarcation point determines who is responsible for wiring, whereas the control point determines who is responsible for device control. For fixed broadband Internet access, the control point today lies at the DSL or cable modem. For wireless broadband Internet access, it lies at the wireless modem that resides within the wireless device. For cable and satellite television, the current control point is murky. However, it should be similarly placed at the modem in the set-top box, as AllVid attempts to do. This control point can be formally defined as follows:

> USER COMMUNICATIONS GATEWAY — The term "User Communications Gateway" means the user device with network layer functionality that is closest to the demarcation point.

The typical location of a user communications gateway is illustrated in Figure 2 below. Recalling that the network layer is OSI layer 3, cable modems, DSL modems, residential gateways, AllVid adapters, and smartphones would all be classified as the *user communications gateway* within their respective architectures. In an IP architecture, when a communications provider allocates only a single IP address for a subscriber, it is assigned to a user communications gateway.

The second issue is which functionality a service provider must control within a user communications gateway. It is typical that a communications provider exercises control over a portion of the user communications gateway. It is atypical that a communications provider exercises control over any devices further into the user's network. As previously noted, in current network architectures most network management lies at layers 1 through 3. This functionality includes the routing of packets between the provider's network and the user communications gateway; the scheduling of packets on links between the provider's network and the user communications gateway; and the transmission of bits on links between the provider's network and the user communications gateway. Using this functionality, a service provider may limit the service purchased by the subscriber – for example a maximum transmission rate specified by the user's subscription plan. Therefore, implementation of a communication provider's right to use reasonable network

management should include layer 1 through 3 functionality at all devices in between the demarcation point and the user communications gateway.

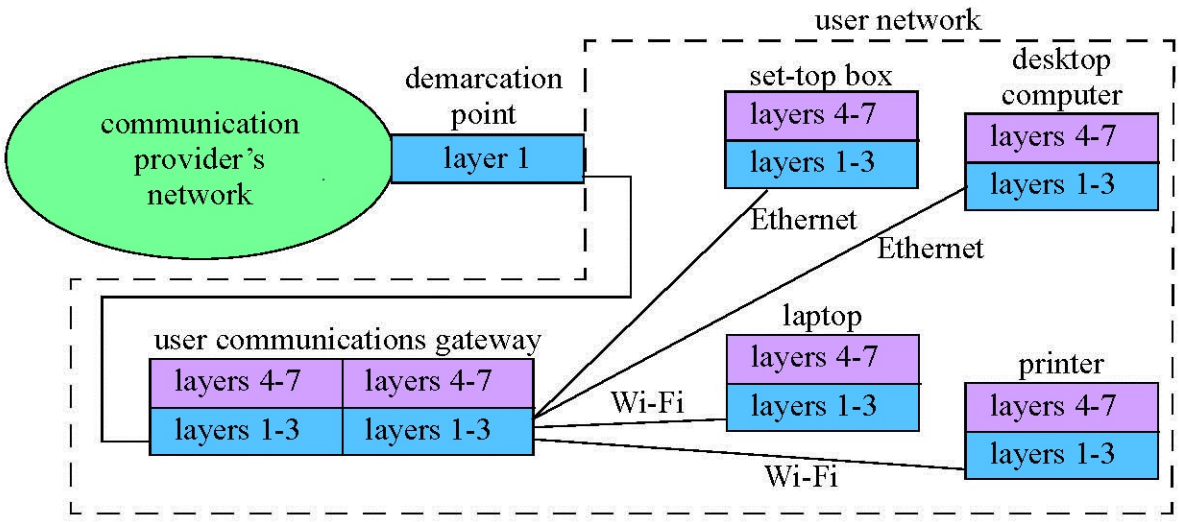

Figure 2: Demarcation Point and User Communications Gateway

However, because service providers commonly control certain higher layer functionality in some devices, this is insufficient. Previous research argues that only the layer 4 through 7 functionality required for managing the network should be allowed.[32] This includes many cable and DSL modem functions, such as the blocking of signaling traffic from the user's residential network to the ISP's network, control over IP address assignment to the modem, operation of network management protocols, and access to content. However, it excludes functionality not required to manage the network, such as navigation guides, blocking applications, application-specific traffic management, and application crippling.

This approach can be used to construct the following limit on a service provider's control:

> CONTROL — (A) A communications provider may exercise control over communications services of all devices between and including the demarcation point and the communications provider's side of the user communications gateway. (B) A communications provider shall not exercise control over any communications or information services not included in part (A) unless it constitutes reasonable network management.

Item (A) ensures the communications provider's right to exercise reasonable network management. The geographical division of control is dictated by the location of the user communications gateway.

[32] Scott Jordan and Arijit Ghosh, "A Framework for Classification of Traffic Management Policies as Reasonable or Unreasonable," *ACM Transactions on Internet Technology* 10, no. 3 (2010): article 12.

The subscriber assumes responsibility for wiring and choice of devices in between the demarcation point and the user communications gateway. However, given proper operation of such wiring and devices, the communications provider assumes responsibility for network functionality in between its network and the user communications gateway. Users are responsible for wiring, devices, and network operation on their side of the communications gateway. The gateway itself, as with all devices, has multiple sides of each layer functional in the device – one side for each physical port. The functional division of control is implemented in the statutory language by use of the term *communications services*. Because communications services include services at or below the network layer, it allows the communications provider to control layers 1 through 3 of all user devices in between the demarcation point and its side of the user communications gateway. Because communications services also include services required to manage the network, the communications provider is allowed to exercise limited control over layer 4 through 7 functionality.

Item (B) ensures the user's right to run any application. The functionality that can be placed by the communications provider in user devices is limited, since it may preempt users from placing competing functionality in other devices of their choice. This provision gives the communications provider the right to place functionality within user devices further into the user's network than the user communications gateway, or at layers 4 through 7, *only* when that functionality constitutes reasonable network management.

This requires a definition of the term *reasonable network management*. Existing laws and regulations offer little useful guidance. The AllVid Notice of Inquiry from the FCC would allow the proprietary adapter to perform "reasonable network management" such as tuning and implementing content protections, while barring the adaptor from performing navigation functions including guides and search. The challenge of defining *reasonable network management* arose in the Open Internet proceeding. Here the FCC settled on the phrase "a network management practice is reasonable if it is appropriate and tailored to achieving a legitimate network management purpose, taking into account the particular network architecture and technology of the broadband Internet access service." [33] The Order prohibits fixed broadband Internet access providers from blocking applications, but only prohibits mobile broadband Internet access providers from blocking applications that compete with the provider's voice or video telephone services – subject to reasonable network management.

Because these multiple models for defining reasonable network management contradict one another, they are doomed to failure as networks converge. They also provide little useful guidance to communications providers as to what network management practices will be deemed reasonable. The need exists for a more precise definition of reasonable network management that can be applied to all types of communications services. For the purposes of this proposed statute, *reasonable network management* need not be defined for all practices, but only for those implemented in user devices.

[33] Federal Communications Commission, *FCC 10-201: Preserving the Open Internet; Broadband Industry Practices, Report and Order (Open Internet Order)*, ¶ 82.

This reduces the burden, since many network management practices are implemented in the communication provider's network. The following definition can be used in this context:

> REASONABLE NETWORK MANAGEMENT FOR USER DEVICES — A network management practice used by a communications provider in a user device is reasonable if and only if the user has control over the use of the practice, or if the practice controls Quality of Service on the basis of reasonable payment.

This definition may appear simple, but it is quite powerful when used in conjunction with the CONTROL provision above. Any network management practice implemented in communications services in between the demarcation point and the user communications gateway need not be deemed reasonable, since they are already allowed under item (A) under the CONTROL provision. This includes traffic management practices such as tiering. The language need then address only practices implemented on the user's side of the user communications gateway, and practices implemented in information services in user devices. The most common practices implemented here are intended to ensure network security and integrity, or to address traffic that is unwanted by users. In nearly all cases, little justification exists for classifying such network management practices as reasonable absent user consent. Traffic harmful to the communication provider's network is already covered under provisions allowing only attachment of devices certified not to cause harm and/or using practices implemented in the communication provider's network. Practices offered by a communications provider to a subscriber intended to ensure security for the subscriber's network and devices, firewalls for example, should be the choice of the user. Similarly, practices to address unwanted traffic, parental controls for example, should clearly be the choice of the user.

The only exception to this rule about user consent is the use of Quality of Service (QoS) to prioritize traffic. To understand this exception, consider the contract between a user and a service provider. A communications provider may implement a charge and the associated limits of a service plan either through action taken inside its own network and/or through action taken in a subscriber's devices. As an example, ISPs sell multiple plans, each offering different maximum upload and download transmission rates. They usually limit the download rate inside ISP equipment, but limit the upload rate by setting parameters in layer 2 protocols inside a subscriber's cable or DSL modem. Any limits on QoS can be handled in a similar manner; in particular, upstream QoS would likely be dictated by parameters in layer 2 and 3 protocols in the cable or DSL modem.

Communications providers typically use two common pricing schemes. First, a provider may charge a fixed fee per unit of time for access. Basic telephone service, unlimited telephone service, most residential Internet access plans through DSL or cable, most cable and satellite television plans, and most cellular voice and data plans follow this model. Second, a provider may charge a usage-based fee, commonly a fee per unit of time or volume. Examples include per-minute telephone service, per-minute cellular voice service, and per-byte charges for cellular data service. These two fee structures are often combined, as can be seen in a cellular voice plan that charges a fixed monthly charge for a specified number of minutes, as well as a per-minute overage charge for additional minutes. In addition, service providers may charge for access to content or for higher layer services.

For instance, an ISP may charge for additional mailboxes or webpage space; a cable or satellite television provider may charge for access to premium channels or pay-per-view; or a cellular provider may charge for ringtones, enhanced mailbox service, or locater service.[34]

Neither fixed fees nor usage-based fees for communications services are controversial. However, the possibility that a communications provider may also charge for QoS has been hotly debated. Some stakeholders argue that communications providers should never be allowed to charge for QoS. Other stakeholders argue that communications providers should be allowed to charge end users but not application or service providers. Finally, some stakeholders argue that communications providers should be allowed to charge end users, as well as application and service providers. A middle-ground approach argues that communications providers should be allowed to charge both residential and business users who are subscribers, but not remote application providers that do not directly connect to the communication provider's network.[35] The statutory language proposed here adopts this latter approach, so long as such charges are not unreasonably discriminatory. On this basis, an exception to the requirement of user consent for reasonable network management is allowed when QoS is based on reasonable payment.

It should be noted that although cable and DSL modems would be allowed under the proposed statute, some residential gateways may be prohibited. Verizon's FiOS provides a residential gateway but does not require its use; any control over the gateway would be allowed since subscriber use gives Verizon consent. By contrast, AT&T's U-verse provides a residential gateway and requires the subscriber to use it. AT&T's control over the gateway would be in partial violation since it incorporates a firewall that the user cannot control. Because this firewall is placed above layer 3 and is not required for managing the network, it unreasonably impairs the subscriber's ability to run applications.

Content Protection and Fair Use

One more issue of control over user devices requires special attention. A subscriber's access to services and content is governed by the provider, either through signaling from the provider's network or by using information stored on the device. In the latter case, content protection is an issue of device control.

In telephone networks, signaling in the communications provider's network typically governs access to telephone service. Control over user devices is unnecessary. When it comes to broadband Internet access service, access is implemented through the setting of parameters both within the ISP's network and in the user's communications gateway, as previously discussed. Access to other upstream services (from the user to the provider's network) can be similarly addressed by this article's proposed CONTROL provisions.

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[34] These are information services, as opposed to communications services, and are thus outside the scope of this article.
[35] Jordan, 427-460.

However, access to downstream content can be limited either by transmitting it only to subscribers (via unicast or multicast), or by transmitting that content to everyone (broadcast) but only allowing subscribers to access it. In the broadcast case, two technologies are employed. First, a provider may use signaling at the application layer – for example, it may issue keys that allow a subscriber to decrypt an encrypted stream. Second, a provider may rely on a physical card that tells a user device whether it is allowed to receive the content, for example a CableCARD or SIM card.

An additional provision is thus required to ensure that information service providers (when they also offer communications service) can use this downstream broadcast technology. An example of statutory language is:

> CONTENT PROTECTION — As part of its Terms of Service for an information service, a communications provider may limit distribution of content to user devices that implement specified nationally or internationally recognized content protection standards, provided (i) these standards are narrowly tailored to content protection, and (ii) such devices do not restrict reproduction or distribution of content for purposes described by the Fair Use doctrine.

While content providers clearly have the right to protect intellectual property from unauthorized commercial reproduction, the Fair Use provisions of US Copyright law allow limited use of copyrighted material without obtaining permission from the rights holders. Examples of Fair Use include reviews, criticism, parodies, educational lessons, news reporting, and library archiving. Section 107 of the Copyright Act of 1976 lays out four factors to be considered when determining whether a specific use is fair: (i) the purpose and character of the use, including whether reproduction is for commercial or nonprofit educational purposes; (ii) the nature of the copyrighted work; (iii) the amount and substantiality of the portion used in relation to the copyrighted work as a whole; and (iv) any impact on the potential market for, or value of, the copyrighted work.[36] Allowing communications service providers to limit redistribution, but not content that qualifies as Fair Use, is a reasonable balance.

TRANSPARENCY AND FORBEARANCE

The remaining user right concerns transparency. Historically, various portions of communications law encouraged transparency. The FCC's Open Internet Order included a provision for both fixed and mobile broadband Internet access service. With slight modification, this can be extended to all communications services:

> TRANSPARENCY — A communications provider shall disclose such information concerning network management and other practices as is reasonably required for users and

[36] Copyright Act of 1976, 17 U.S.C. §107 (1976).

content, application, and service providers to enjoy the protections specified by user rights U1, U2, and U3.

Finally, a communications provider's right to forbearance from regulations that are unnecessary to ensure user rights should be implemented. Title I of the Communications Act instructs the FCC to forbear from applying regulations if: (1) enforcement is not necessary to ensure that charges, practices, classifications, or regulations in connection with the telecommunications carrier or telecommunications service are just and reasonable and not unjustly or unreasonably discriminatory; (2) enforcement is not necessary for the protection of consumers; and (3) forbearance is in the public interest. This right to forbearance should apply to *communications services*.

It is reasonable to expect that that the transparency requirement would always be in the public interest. The generalization of Part 68 regulations to all communications services would also be in the public interest in nearly all situations – since conformance comes at little cost or restriction to innovation, forbearance from this provision should be rare. Similarly the enforcement of users' rights to run applications of their choice would be in the public interest in nearly all situations for similar reasons, making forbearance similarly rare. In contrast, when sufficient competition exists, market forces may be judged to adequately limit device subsidies and early termination fees. In such situations, forbearance may be applied to the proposed provisions for standalone services, limits on subsidies, and limits on early termination fees.

CONCLUSION

This article proposes a statute for device attachment and control in converged communications networks. The proposed statute ensures users the right to connect devices of their choice while simultaneously ensuring network providers the right to reasonable network management. Table 1 compares this proposed statute to current law for telephone networks, cable and satellite MVPD networks, cellular networks, and the Internet. The proposed statute eliminates separate device attachment rules for telephone, cable television, satellite television, and cellular networks, as well as for the Internet.

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