

# Platform Models for Sustainable Internet Regulation

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## Abstract

The dynamic nature of the telecommunications industry, with its rapidly changing technology and industry structure, presents a serious challenge to the theory and practice of regulation, which has a slower response time and a tendency to embed assumptions about technology and industry into regulation. This paper proposes a model that attempts to capture two durable and persistent features of today's telecommunications ecosystem: the use of layered platforms to implement desired functionality; and interconnection between actors at different platform layers. We use platform theory, and in particular theories of multi-sided platforms (MSPs), to focus on key technical and business aspects of today's industry. We use an MSP-aware layered model of the ecosystem to explore several recent and impending innovations in the ecosystem that have been naively conflated with the global Internet, illuminate their differences, and describe how regulators could use our model to more rigorously consider them. To illustrate its potential as a baseline for future research, we briefly consider how this model can help scope consistent policy discourse of three policy challenges: specialized services, minimum quality regulations ("the dirt road" problem), and structural separation.

## 1 Introduction

A significant challenge in developing regulatory theory to support communications policy is the highly dynamic range of technology and business practices in the evolving Internet. Traditional regulatory theory in the telecommunications sector relied on simple conceptions of technology, such as copper pairs carrying telephone service to homes. Innovative uses of that copper pair (e.g. DSL) and advanced technologies such as hybrid fiber-coax (HFC), fiber, and wireless, have led to definitional confusion, litigation, and a dauntingly complex, poorly understood networked ecosystem. The recent trend, present in virtually all public and private communication networks, of using the Internet Protocol (IP) as a universal mechanism for data transport, has not simplified matters, instead only adding ambiguity to the complexity.

The goal of this paper is to present a model of communications technology and industry practice that is general enough to survive current rates of innovation and evolution, and stable enough to support relevant regulatory theory. Our underlying premise is that regulations most likely to succeed are anchored around stable characteristics of the regulated ecosystem, including the network architecture itself; otherwise regulations are at risk of irrelevance as their terminology becomes obsolete. We draw on two fundamental elements of today's telecommunications ecosystem: the use of layered platforms to implement functionality desired by users or providers; and interconnection between actors at different platform layers to construct a larger fabric. The concepts of platforms, layering, and interconnection are not new; but our model combines them in a way that captures both stable and dynamic aspects of technology and business practices of the ecosystem, while abstracting away details that confuse more than clarify regulatory debates.<sup>1</sup>

Section 2 describes a taxonomy of platforms classified across two dimensions: how they are constructed (one or multiple firms) and how they are used (only by the platform owners or by others). The Internet and its larger ecosystem is actually many layers of platforms that span all four combinations of these two dimensions. We augment this classification with a well-accepted model of contemporary interconnection patterns among ISPs, and find that the resulting picture brings some clarity to differences among several recent Internet-related service offerings

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<sup>1</sup> Recent events in the United States illustrate the turbulence of today's telecommunications policy environment, in particular fervent debate over which classes of networked communications services warrant regulatory oversight. In January 2014, U.S. courts overturned most of the FCC's 2010 Open Internet Report and Order, which had tried to differentiate "specialized services" from those subject to the rules of the Order. (Federal Communications Commission, Report and Order, Preserving the Open Internet, FCC10-201, [http://hraunfoss.fcc.gov/edocs\\_public/attachmatch/FCC-10-201A1\\_Rcd.pdf](http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-10-201A1_Rcd.pdf), December 2010; D.C. Cir., Verizon vs. FCC, 740 F.3d 623, available at [http://www.cadc.uscourts.gov/internet/opinions.nsf/3AF8B4D938CDEEA685257C6000532062/\\$file/11-1355-1474943.pdf](http://www.cadc.uscourts.gov/internet/opinions.nsf/3AF8B4D938CDEEA685257C6000532062/$file/11-1355-1474943.pdf), 2014) The court judged the ultimate goals of the Order to be reasonable, but its justifications inconsistent with the FCC's own previous classification of Internet access as an information service rather than a regulated telecommunications service. In response, in May 2014 the FCC issued a Notice of Proposed Rulemaking (NPRM), proposed a new approach to regulating Internet services, which similarly precluded blocking, but with a different legal justification: rather than prohibiting unreasonable discrimination, the proposal used a standard of commercially reasonable practice. (Federal Communications Commission, Notice of Proposed Rulemaking, In the Matter of Protecting and Promoting the Open Internet, GN Docket No. 14-28, available at <http://www.fcc.gov/document/protecting-and-promoting-open-internet-nprm>, 2014.) The NPRM does not further elaborate the role of specialized services. Europe has also tried to exempt "specialised" services, using different criteria. (European Parliament, European Parliament legislative resolution on the proposal for a regulation of the European Parliament and of the Council laying down measures concerning the European single market for electronic communications, <http://www.europarl.europa.eu/sides/getDoc.do?type=TA&reference=P7-TA-2014-0281&language=EN>, April 2014.) Both the U.S. and European approaches are using a rather circular definition, i.e., that a "specialized service" is a service defined to be outside the scope of the regulation. In pursuit of a more lasting framework to support policy development, we use a network architecture perspective to develop a model of ISP service offerings that can inform a range of regulatory options. Section 3.4 applies our model in the context of the Order's rules against discrimination.

and their regulatory implications. We use this taxonomy to explore two platform layers of the ecosystem that seem particularly durable: the global Internet and the single-firm IP platform. A third emerging platform innovation – the multi-firm IP platform – is also likely to become common, which raises significant challenges for regulators. We explore how a platform-aware model can usefully distinguish among services running on different IP-based platforms, as well as the possible behavior of those platform owners, in a way that offers a cleaner derivation and clearer interpretation of their regulatory implications.

In Section 3 we introduce the concept of a multi-sided platform (an MSP, a type of multi-sided market) and use existing MSP theory to develop an approach to analyze possible harms induced by discriminatory behavior by the platform owner.<sup>2</sup> Section 4 considers how our framework of platforms and MSP analysis can help scope consistent policy and regulation of the Internet. We examine how our framework can inform three lively policy debates: specialized services, minimum quality regulations ("the dirt road" problem), and structural separation. These three debates reflect the reality of network providers offering services on multiple IP-based platforms, and we demonstrate that our MSP framework can provide a foundation for regulatory reasoning about these business practices. Section 5 offers concluding thoughts and suggests future directions of research and policy discourse.

## **2 Platforms: their nature and layered structure in the Internet**

A platform is a technology providing a set of service capabilities on top of which many different products can be developed and deployed. Operating systems (e.g., Microsoft Windows, iOS, Android) are platforms – they support a wide variety of applications and services, often provided by many third-party providers. The owner of a successful platform may acquire powerful advantages in the related industrial ecosystem. Factors that influence the ability to create and control a successful platform include the dynamics of gaining and holding market share, network externalities, and control of intellectual property.

In the context of industrial structure, Gawer described three classes of platform: internal, supply chain and industry.<sup>3</sup> Internal platforms are developed and exploited internal to a firm to reduce cost and improve flexibility and time to market for product development. Examples of internal platforms are often found in manufacturing industries such as automotive and electronics. Supply chain platforms are produced and exploited by a set of firms, linked in collaborations and alliances. An industry platform is produced by one or a set of firms and then made

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<sup>2</sup> See for example Kevin Boudreau and Andrei Hagiu, "Platform Rules: Multi-sided Platforms as Regulators," in *Platforms, Markets and Innovation* (Edward Elgar, 2011); Andrei Hagiu and Julian Wright, *Multi-Sided Platforms*, technical report 12-024, available at <http://hbswk.hbs.edu/item/6681.html> (Harvard Business School, 2011).

<sup>3</sup> Annabelle Gawer, "Platform Dynamics and Strategies: From Products to Services," in *Platforms, Markets and Innovation* (Edward Elgar, 2011).

available to other entities (complementors) to develop products on top of that platform.

To clarify their role in our model, Figure 1 depicts four types of platforms (and examples of each) along two dimensions: construction and use. The upper row corresponds to Gawer's industry platform, but distinguishes between those constructed by one vs. multiple firms. The right column generalizes Gawer's supply chain platform to include cases where firms are peers or partners. Gawer's analysis still applies to multi-firm platforms, i.e., relationships among firms producing the platform influence which firms may have sufficient market power to define and regulate the platform, or even destabilize it in the process of trying to maximize profit.

		Construction:	
		One firm	Several firms
Use:	INDUSTRY (External)	Single firm industry platform (iPhone, Android, Microsoft Windows, Facebook)	Multi-firm industry platform (Internet)
	INTERNAL (To the creators)	Internal single-firm platform (TV over HFC, IPTV over IP)	Internal multi-firm platform (VoIP over IP platform)

Figure 1: Two important aspects of a platform: how it is constructed and who its users are. The global Internet is an example of an external or industry platform produced by many firms. The upper left box (an industry platform produced by one firm) is not common in the Internet context, but we predict it will become more common in the future, with important implications for any theory of broadband regulation.

Microsoft Windows is an example of an industry platform, defined and developed by one firm that controls it through intellectual property licensing and other methods to limit appropriation of the platform by competitors. The Internet as we know it today is a multi-firm industry platform, constructed by many firms interconnecting their networked assets based on (mostly) open standards. One of the most successful industry platforms in history as measured by the range of innovative applications built by complementors using it, the Internet is embedded in a larger ecosystem composed of many layers of platforms that span all four quadrants of figure 1.

For example, the Web is also a multi-firm platform, implemented at a layer above the basic Internet transport capability, and applications using this higher-level web platform can themselves serve as platforms for other application developers. Like the Internet, the Web is defined by standards, mostly set by the World Wide Web Consortium (W3C) hosted at MIT, with many actors involved in both setting the standards and implementing them in web servers and browsers. On top of the Web platform one can find further examples of platforms. Facebook is a single-firm industry platform for complementors who build on top of it. In contrast to the Web platform, which is largely characterized by open standards, the Facebook platform is dictated by its owner, shaped only by any pressures from their complementors and users that they choose to respect. While there have been fears that a powerful player might try to distort a web standard using the market share of their browser,

the need for interoperability among tools (firms) seems to have prevented serious fragmentation of the Web standards.<sup>4</sup>

The repeating platform structure of the Internet also appears below the network layer, down to the physical layer of routers and fibers. Internet service providers deploy routers and fiber in order to build and maintain their parts of the Internet. But these technologies also enable individual providers to construct a stack of internal platforms to support a range of services by the firm, or to create additional industry platforms for complementors. In network architecture language, these repeating layers may multiplex, i.e., simultaneously support, many higher-level services. Long distance fibers are multiplexed by using different colors of light (lambdas) to carry different data streams. These data streams are often multiplexed using technologies such as Multi-Protocol Label Switching (MPLS) or Ethernet, which breaks the data stream into packets. The most common format for these packets is the Internet Protocol (IP), which results in an IP-based platform. *From the perspective of each ISP, their IP platform is a single-firm platform, while the Internet is a multi-firm platform that happens to use the same protocol.* At the same time, lower layers can serve as both an internal platform and an industry platform, i.e., the owner of a fiber infrastructure can both use internally and sell to others a fiber, a lambda, a share of an MPLS service, a range of IP-based services, or access to the public Internet.

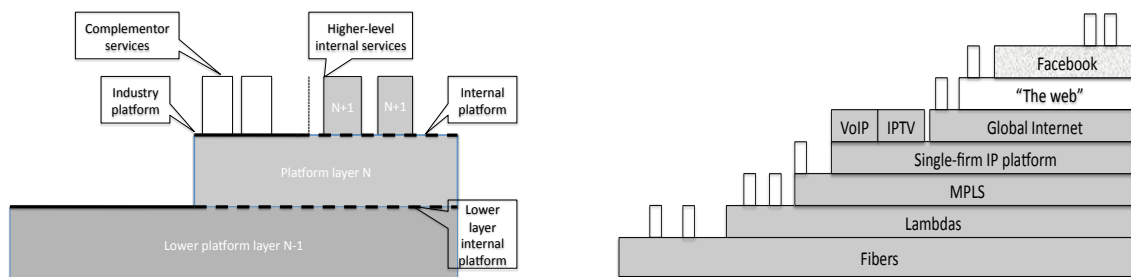
The significance of these layers inspires the *repeating platform layer* dimension of our model. Figure 2(a) illustrates how each layer sits on a lower-layer platform that supports a range of internal as well as complementor services; figure 2(b) provides an example set of such platform layers in the Internet ecosystem. Layered models have been used for at least a decade to explain the structure of network technology, and to reason about regulatory treatment.<sup>5</sup> More recently, Jordan argued for the Internet Protocol layer as a critical demarcation point between layers below and above it, which he believes could recover some meaning to the telecommunications vs. information service terminology in the U.S. Telecommunications Act, and also promote innovation at higher layers in the industry by limiting regulation to the lower layers.<sup>6</sup> Our model differs from his in that it distinguishes among platforms, specifically the multi-firm industry IP platform (i.e., the global Internet) and other

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<sup>4</sup> For a range of commentary on powerful actors manipulating key web standards, see for example <http://www.internetnews.com/dev-news/article.php/83051/Web+Standards+Group+Criticizes+IE+5.htm> (1999) or <http://developers.slashdot.org/story/12/08/10/2152236/microsoft-picks-another-web-standards-fight> (2012).

<sup>5</sup> See for example Douglas Sicker and Joshua Mindel, "Refinements of a Layered Model for Telecommunications Policy," *Journal on Telecommunications and High Technology Law* (2002): 69–94; Philip J. Weiser, "Law and Information Platforms," *Journal on Telecommunications and High Technology Law* (2002): 1–36; Kevin Werbach, "A layered Model for Internet Policy," *Journal on Telecommunications and High Technology Law* (2002): 37–68

<sup>6</sup> Scott Jordan, "A Layered Network Approach to Net Neutrality," *International Journal of Communication* 1 (2007):427–460.



(a) Platforms sitting on lower layer platforms that can provide both an industry and internal platform to services above.

(b) In the Internet ecosystem, fiber owners may be able to create multiple platform layers, each one serving as an industry platform as well as an internal platform for the development of higher-level services.

Figure 2: Illustration of platform layers and their role in the Internet ecosystem

IP-based platform offerings, since we believe this distinction is relevant to regulatory analysis.

More to the point, one of our objectives is to identify platform layers that are likely to be stable over time, because we argue that by framing policies in terms of stable classes of platforms, rather than details of technology, resulting regulations are more likely to survive technical innovation and evolution. For example, the physical layer has a durable character; its creation is typically capital-intensive and its evolution constrained accordingly. However, technology evolution and dynamism bring tremendous variability to the intermediate lower layers of this stack, resulting in different intermediate platforms, so any attempt to attach regulatory burdens to a specific technical implementation of a layer runs the risk of rapid irrelevance. For example, in contrast to the MPLS platform layer in figure 2(b), the HFC infrastructure of a modern cable access system implements multiplexing using a platform layer based on a protocol called DOCSIS. DOCSIS 3.0 uses 6Mhz channel allocations, but any regulation described in terms of these channels, e.g., to implement unbundling requirements, would soon be obsolete since DOCSIS 3.1 eliminates these channels altogether.

More generally, a durable model will identify key features that merit different regulatory treatment of different layers, regardless of the technical details of a given layer at a given time. Such a model will facilitate analysis of emerging platform innovations that are about to break our already cracking models of communication regulation. The first such innovation we explore is the "single-firm converged IP platform", often naively conflated with the public Internet.

## 2.1 The single-firm IP platform

Most Internet Service Providers have historically provided many services in addition to the public Internet. These services, such as telephone and cable television, create additional revenue opportunities. Today, a common technical

approach to providing these other services is for a firm to build a *single-firm IP platform*, a converged service layer based on the Internet protocols (IP), over which the infrastructure owner can offer its own voice (VoIP) or video (IPTV) services, as well as to provide an industry platform such as the public Internet. A single-firm IP platform can support enhanced service qualities (e.g., QoS) that may not be permitted on the Internet platform due to regulatory restrictions. The term converged captures the idea that this layer brings together disparate lower-level technologies under one service interface. The IP platform is powerful and successful because the Internet protocols were designed to support exactly such an objective: provide a layer that implements a uniform service interface on top of a variety of lower-level technologies and platform interfaces.

This new reality changes the context for reasoning about the role and necessity of regulation. Under the assumption that the major purpose of the IP platform was to implement the public Internet, regulatory proposals that tried to constrain the relationship between the ISP and the complementors (e.g., "network neutrality" regulations) considered only the industry platform that provided the global Internet. Proponents of network neutrality (or "reasonable network management," as the FCC has termed it<sup>7</sup>) are concerned with the potential chilling effect on complementors if the Internet provider favored (in pricing or performance) their own higher-level services over products and services from complementors. But the regulatory proposition is more complex if the owner of the single-firm IP platform can also sell consumer-facing services on top of this internal platform instead of or as well as selling access to the global Internet.

We cannot easily dismiss these multiple uses of the single-firm IP platform, since they may be the only way to recover the costs of operating the underlying infrastructure in a competitive market. For example, access ISPs today offer what is sometimes called the triple play over their access technology – voice, video and Internet; revenues from all of these services cover the costs of the infrastructure. The FCC concurred with this assessment of the economics of competitive broadband access in their ruling on

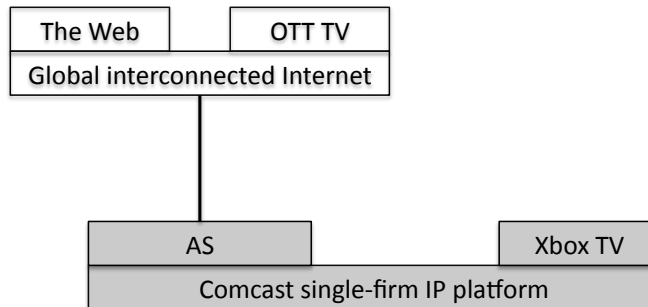


Figure 3: *Delivery of Comcast Xfinity video over their converged IP platform, in contrast to over the top (OTT) video being delivered by competitors over the Internet.*

<sup>7</sup> Federal Communications Commission, Report and Order, Preserving the Open Internet, FCC10-201

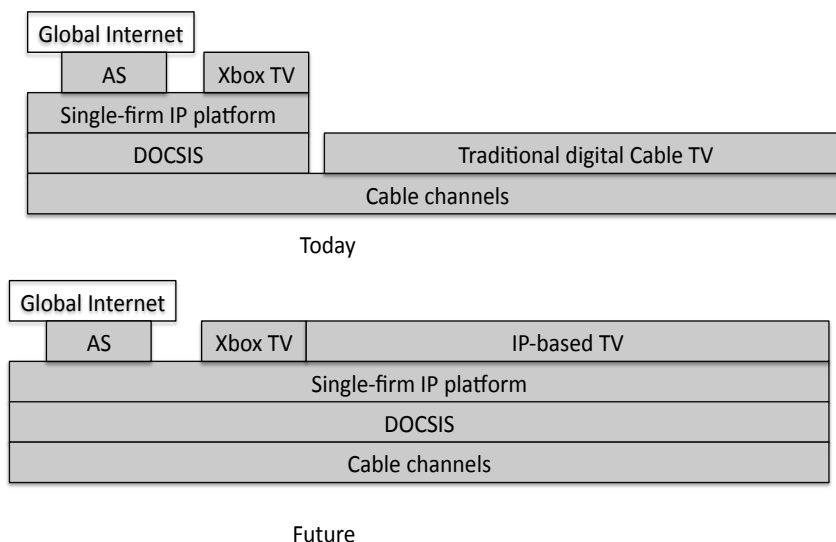


Figure 4: *Most cable TV providers will migrate TV onto their single-firm converged IP platform. No IP interoperation (i.e. over a multi-firm platform) is required to deliver IPTV.*

local franchising of cable competitors, acknowledging that IP packet transport is not by itself amenable to a sustainable competitive market.<sup>8</sup>

As an example of a service offered over a single-firm IP platform, Comcast has introduced an Xfinity Xbox IPTV service, which carries on-demand television content over IP to a customer's Xbox for display on an attached monitor or television (figure 3). Comcast described this service as a consumer-facing service running on top of their single-firm IP platform, not the public Internet platform, and asserted that it was thus not covered by the obligations against discrimination imposed by the FCC's Open Internet Report and Order. They exempted the usage attributed to this service from the monthly quota on their Internet service. Critics argued that the Xfinity Xbox service should be viewed as operating on the global Internet platform, and therefore Comcast should (under the Open Internet Report and Order) treat it equally to other video services and include it in the cap.<sup>9</sup>

This debate will intensify as all of cable television service will eventually move to this single-firm IP platform layer model, i.e., TV will become IPTV (figure 4), which does not imply it is running as just another application on the global Internet. New services, many with no prior regulatory baggage, will emerge. A challenge for regulators is to assess the implications, both positive and negative, of the emergence

<sup>8</sup> Federal Communications Commission, In the Matter of Implementation of Section 621(a)(1) of the Cable Communications Policy Act of 1984 as amended by the Cable Television Consumer Protection and Competition Act of 1992, MB Docket No. 05-311, FCC 06-180, 2005, para 51.

<sup>9</sup> One perspective: Stacey Higginbotham, "The technical and legal realities of Comcast's Xbox cap spat," <http://gigaom.com/2012/03/27/the-technical-and-legal-realities-of-comcasts-xbox-cap-spat/>, GigaOm (July 2012).

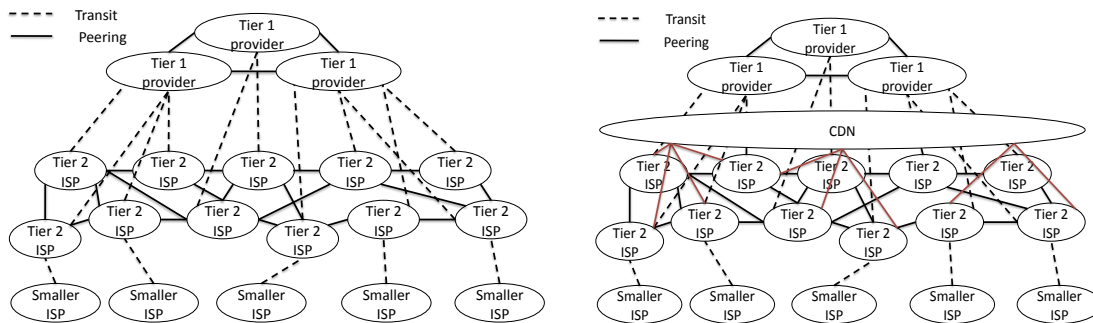


of consumer-facing services offered by facilities owners over their single-firm (internal) IP platform.

## 2.2 From internal platform to industry platform

Further complicating the analysis, a firm could convert their internal platform to an external (industry) platform, by allowing complementors access (i.e., direct interconnection) to this platform (thus moving from the lower left to upper left quadrant of the matrix in figure 1). Such a transition is illustrated by reported discussions of a possible partnership that would give Apple direct access to Comcast customers over Comcast's single-firm IP platform rather than over the public Internet, presumably getting assured quality of service for their streaming product.<sup>10</sup> This possibility presents a fundamental question: if the single-firm IP platform and the global Internet both support complementors, perhaps some of the same complementors, in what respects are they different platforms? Should they receive different regulatory treatment? Alternatively, two firms might agree to interconnect their internal IP platforms for a specific purpose, shifting along the other dimension of the platform matrix (from the lower left to lower right quadrant of figure 1).

Before we explore the difference between interconnection to create a platform and interconnection to use it, we summarize the four important aspects of the ecosystem our model has captured thus far. First, the ecosystem has many layers, sometimes recursive (IP on top of another IP layer), and with technical details that change rapidly enough that a stable and general model of regulation will have to



(a) Physical representation of Internet interconnection.

(b) The addition of a content delivery network (CDN) to the mix of interconnections.

Figure 5: Both the multi-firm production of the global Internet and the interconnection of complementors such as CDNs may manifest as physical links in a diagram of the Internet.

<sup>10</sup> Shalini Ramachandran, Daisuke Wakabayashi and Amol Sharma, “Apple in Talks With Comcast About Streaming-TV Service,” Wall Street Journal (March 2014).

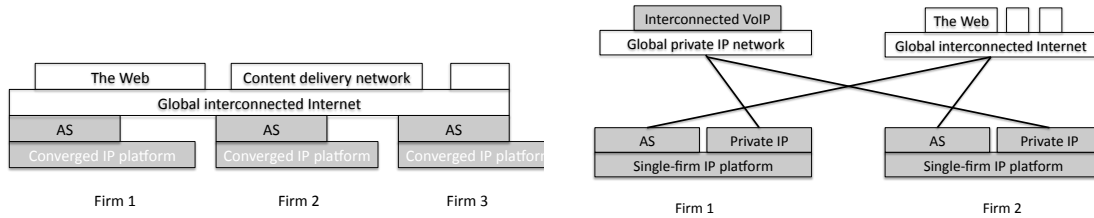
ignore them. Second, one can reason independently of these technical details by first characterizing platforms along the two dimensions in our matrix: whether they are internal or industry platforms, and whether they are single or multi-firm platforms. Third, the emerging single-firm IP platform is likely to be stable and persistent, which means our model has at least two durable layers: the global Internet and the single-firm IP platform. Fourth, we anticipate a third type of IP platform becoming more prevalent: the multi-firm IP platform, which may serve both as an industry or an internal platform. We next examine issues related to such multi-firm platforms, of which the Internet itself is the most recognized one.

### **2.3 From single-firm platform to multi-firm platform (today's Internet)**

We have described the global Internet as an industry platform composed of an interconnected mesh of many single-firm IP platforms. Interconnection is the process, evolving for the last several decades, of building a multi-firm platform out of the single-firm IP platform of each ISP.

Internet interconnection patterns have evolved over the past decades. In the past, while most traffic used to travel up to a Tier 1 provider on its way to its destination, over the years more traffic began to pass over a dense mesh of Tier 2 ISPs rather than transiting major Tier 1 providers. Figure 5(a) illustrates the resulting mesh of Tier 2 peering. The more interesting recent evolution, from a platform perspective, is the emergence of large content delivery networks (CDNs), which attach to the various regions of the Internet to facilitate efficient delivery of content, as illustrated in figure 5(b). This figure emphasizes the physical topology of interconnection, not distinguishing CDNs from ISPs in terms of their role in the ecosystem.

Illustrating interconnection in terms of layers of platforms (figure 6(a)) clarifies this distinction. Content delivery networks operate at a layer above the global Internet platform, because their role in the ecosystem is not general interconnection among firms that constitute the global Internet, but rather as a downstream delivery service for content providers. A CDN is a complementor of the ISP platforms to which it connects, as well as being another platform in its own right, acting as a delivery enhancement mechanism for a range of higher-level services. Content-related complementors (e.g. a CDN and its customers) are superficially similar to ISPs: they have AS numbers, interconnect with other ISPs, etc. But interconnection between a CDN and a broadband access provider crosses platform layers, between complementor and Internet. In other words, some physical interconnection involves construction of the multi-firm platform, and some interconnection represents use of that platform.



(a) *Platform model of the multi-firm Internet, created by interconnecting Autonomous Systems (ASes), i.e., parts of the global Internet operated by one firm.*

(b) *Both the global Internet and a multi-firm internal IP network built by interconnecting the platforms of multiple firms.*

Figure 6: *The converged IP platform supports two global platforms: (a) the public Internet and (b) a private IP network. Lines in (b) represent physical interconnections as well as connections between platform layers.*

Spulber and Yoo identify five sorts of interconnection that occur in the Internet: retail (endusers), wholesale, interconnection (multi-firm production of the Internet platform), platform (the complementors) and unbundled access (unbundling at the physical layer).<sup>11</sup> They stress the difference between the retail and platform interconnection, although they discuss the platform interconnection mostly in terms of access to TCP/IP, rather than as physical interconnection. They recognize, as we stress, that two sets of links may be identical in terms of physical properties but different in terms of economic relationships, and their economic analysis distinguishes regulatory implications for each of these forms of interconnection.

## 2.4 Alternative multi-firm IP platforms

A more recent development in this evolutionary trajectory is that firms that have built the multi-firm global Internet by interconnecting their single firm platforms are replicating this approach to produce other multi-firm IP (but not Internet) platforms. The initial role seen in practice for such a network is as an internal platform, serving the firms that create it. For example, some firms that offer VoIP have created a second connected mesh of private IP services over which to interconnect VoIP calls. Figure 6(b) illustrates the creation of both the global Internet (an industry platform) and a multi-firm internal IP platform established by the interconnection of single-firm platforms across multiple firms. Exactly such a multi-firm platform is used today to provide VoIP services; called the IP eXchange (IPX) architecture,<sup>12</sup> it offers enhanced quality of service, better security, and service-specific payment flows not feasible to implement on the global Internet.

<sup>11</sup> Daniel F. Spulber and Christopher S. Yoo, “Network Regulation: The Many Faces of Access,” *Journal of Competition Law and Economics* 1, no. 4 (2005): 635–678, available at <http://jcle.oxfordjournals.org/content/1/4/635.full.pdf+html>.

<sup>12</sup> <http://www.gsma.com/technicalprojects/technical-programme>, visited 13 August 2014.

Just as a single-firm IP platform can serve as an industry platform as well as an internal platform, a multi-firm IP platform could be offered as an industry platform to complementors. Such an interconnected IP platform would be an alternative (to the Internet) industry platform for third-party complementors to reach consumers instead of the current global Internet. An infrastructure provider might market such a platform to large application providers such as Facebook as a more effective way to reach consumers, e.g., see figure 7. For example, Blackberry uses IPX to carry its messaging service.

Since both the private industry platforms and the public Internet are based on the same (IP) protocols, and yet they may merit different regulatory treatment, we must identify criteria that clarify which platform offers a given service. For a single firm platform, an obvious test is that the service is only available to customers directly attached to that platform. So, in the case of the Comcast Xfinity service, only users directly attached to Comcast could use it. For the IPX multi-firm platform, a criterion might be its segregation of IP addresses from the Internet, which is a critical feature with strong security implications.<sup>13</sup>

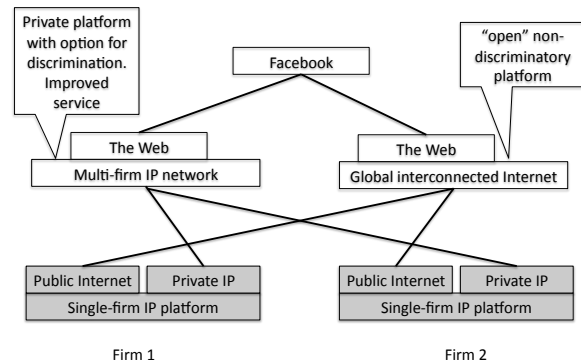


Figure 7: Both the global Internet and a multi-firm IP network act as alternative industry platforms for consumer-facing services.

The FCC introduced the term "specialized services" to describe services that in our model are provided over private IP platforms. The FCC's Open Internet Report and Order, as well as the recent resolution of the European Parliament on electronic communications, both attempt to describe when a service is a "specialized" service and not an Internet service subject to Internet regulations. The European Parliament proposed the following criteria:<sup>14</sup> "'specialised service' means an electronic communications service optimised for specific content, applications or services, or a combination thereof, provided over logically distinct capacity and relying on strict admission control with a view to ensuring enhanced quality from end to end and that is not marketed or usable as a substitute for internet access service". Comcast, in describing their Xfinity IPTV service, also stressed that the

<sup>13</sup> "The IPX is not addressable from the Internet which makes attacks much more difficult." <http://www.gsma.com/technicalprojects/technical-programme/ip-exchange>

<sup>14</sup> Article 2, paragraph 2, point 15 of Parliament, *European Parliament legislative resolution on the proposal for a regulation of the European Parliament and of the Council laying down measures concerning the European single market for electronic communications.*

IPTV and Internet service use different logical slices of Comcast's bandwidth capacity.<sup>15</sup> For both single-firm and multi-firm IP platforms, the inevitable question for the regulator is how to view companies building, interconnecting, and selling services on their own private IP-based platforms, logically if not physically separate from the global Internet platform (discussed in Section 4.1).

In this section we have mapped various IP-based platforms into our matrix of options for the creation and use of platforms. We have shown examples of an IP platform in each of the four quadrants, and explained how a platform-aware understanding of interconnection can shed light on otherwise confusing innovations in the ecosystem. Next we introduce another relevant aspect of platform theory that is essential to understanding the economics of today's Internet infrastructure: the multi-sided platform, or MSP.

### 3 Multi-sided platforms (MSPs)

A Multi-Sided Platform (MSP) is a special case of a multi-sided market. A multi-sided market is a circumstance in which a provider has several classes of mutually dependent participants. Hagiu calls these classes of participants *customers*;<sup>16</sup> we use the term *participant* to emphasize that an association with the provider may not imply payment, and restrict the term *customer* to situations where payment is explicit. A classic example of a multi-sided market is a dating club, where both men and women must attend for the club to succeed, and a club owner might offer men and women different prices to entice them both to come, because of a perception that men and women attach different values to the experience. An MSP, by analogy, is a platform that requires several classes of participants to partake in order for the platform to succeed.

Using this framework, we can view the global Internet as an MSP, with retail users as one class of participants and complementors as another. Complementors may participate in a number of ways: providing software, web content, gaming, music sharing, or other services. Complementors and users are mutually dependent; for any activity involving both classes, there is a balance between their roles. Wikipedia is a complementor on the global Internet platform that provides a service (itself a single-firm industry platform) to enable users (contributors) to produce value. For peer-to-peer file sharing, the complementor only produces and perhaps maintains the sharing software, and users create value by using it. For commercial content creation and distribution, the user is a somewhat passive consumer and the complementor drives production.

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<sup>15</sup> <http://corporate.comcast.com/comcast-voices/the-facts-about-xfinity-tv-and-xbox-360-comcast-is-not-prioritizing>, visited 13 August 2014.

<sup>16</sup> Hagiu and Wright, *Multi-Sided Platforms*

Although the MSP model legitimately applies to the global Internet, from both a business and regulatory perspective the unit of concern is usually the firm (or a class of firms, like broadband access providers), not a multi-firm platform. According to Hagiu,<sup>17</sup> an MSP's classes of participants must have a direct association with the platform provider, and most complementors of the global Internet today do not have a direct relationship with any given access provider.<sup>18</sup> On the other hand, such direct relationships between some complementors and access ISPs are becoming more common, moving individual access ISPs toward an MSP role in the ecosystem. Most notably, large content providers such as Netflix and Google, as well as CDNs that serve content on behalf of many other content providers, often negotiate business relationships that result in direct interconnection to access ISPs, as illustrated in figure 5(b). Physical interconnection can thus constitute either the production of the multi-firm Internet platform or the connection of a complementor to an IP platform; supporting this latter type of interconnection turns an access ISP into an MSP. As another example of a direct association between access ISP and complementor, HBOgo (the Internet version of HBO) relies on the access ISP to verify that a specific user has the right access credentials based on that customer also subscribing to HBO via their cable TV service. Similarly, ESPN requires that access ISPs pay a fee to ESPN in order that its users have access to the Internet ESPN service, called ESPN3.

### 3.1 Regulatory implications of a multi-sided platform model

Analyses of multi-sided markets usually focus on differential pricing,<sup>19</sup> but much of the concern today with regulation of access ISPs relates to other forms of discriminatory behavior, e.g., blocking or variable quality of delivery of content from complementors. In an analysis of regulatory implications of MSP behavior, Evans concludes that a potential regulator must be cautious about determining predatory pricing in an MSP, as the price on one side may be efficiently set above or below cost, as part of the overall pricing analysis.<sup>20</sup> Generalizing Evans' argument suggests that not just pricing but all forms of potential discrimination should be evaluated with regard to all classes of participants. Several researchers have explicitly argued that certain forms of discrimination can enhance the overall health of an MSP.<sup>21</sup>

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<sup>17</sup> Hagiu and Wright, *Multi-Sided Platforms*

<sup>18</sup> By this definition, one could view advertising-supported access providers (such as some Wi-Fi spots in airports) as two-sided platforms, with users and advertisers as two classes of participants.

<sup>19</sup> Jean-Charles Rochet and Jean Tirole, "Two-Sided Markets: A Progress Report," <http://www.jstor.org/stable/25046265>, *The RAND Journal of Economics* 37, no. 3 (Fall 2006): 645–667.

<sup>20</sup> David A. Evans, "The Antitrust Economics of Multi-sided Platform Markets," *Yale Journal on Regulation* 20, no. 2 (2003).

<sup>21</sup> Thomas Eisenmann, Geoffrey Parker, and Marshall Van Alstyne, "Open Platforms: How, When and Why," in *Platforms, Markets and Innovation* (Edward Elgar, 2011); Shane Greenstein, "Open Platform Development and the Commercial Internet," in *Platforms, Markets and Innovation* (Edward Elgar, 2011); Boudreau and Hagiu, "Platform Rules: Multi-sided Platforms as Regulators". Eisenmann *et al.* examined both vertical and horizontal interfaces of a platform, which we describe as the complementor interface and multi-firm interconnection, respectively.

A particularly successful example, the Apple app store (a single-firm industry platform) is an MSP with two classes of participants: application designers and purchasers. Apple discriminates among applications (complementors). While this business strategy may restrict competition and innovation at the level of the complementors, a thorough MSP analysis should examine the impacts on all platform participants. Discrimination with respect to applications arguably makes the platform more attractive to users, by giving them confidence that undesirable or risky applications have been removed from the system. This outcome might in turn increase uptake of the platform, making it more attractive to complementors. (Note the large difference between an MSP exercising some degree of discrimination with respect to a complementor class and a powerful MSP blocking a popular application, perhaps as an exercise in rent-seeking or protection of a vertically integrated complementor. Apple removed the Google maps app from the iPhone in favor of their own maps, triggering a significant consumer backlash.)

In the remainder of this section we explore how multi-sided platform theory can influence discourse on discrimination by platform owners against complementors and retail users.

### 3.2 Discrimination with respect to Internet complementors

Analysis of the consequences of a particular form of discrimination will depend on the higher-level goal that drives the call for non-discrimination. Why are advocates and regulators concerned about non-discrimination on the Internet? One goal is fostering innovation, i.e., nondiscriminatory access protects complementors,<sup>22</sup> an explicit priority of the FCC's National Broadband Plan, which uses the word "innovation" 260 times. Others have argued that non-discriminatory access fosters the production of public and social goods.<sup>23</sup> But as Evans' argument suggests, and Apple's ecosystem demonstrates, some forms of discrimination with respect to the complementors might result in a platform that appeals to more users, and thus fosters more production of downstream goods. The potential complexity of the MSP suggests that protection of complementors and promotion of downstream goods (including public and social goods) merit distinct regulatory analysis regarding discrimination.

With respect to complementors, ISPs impose coarse discrimination behavior today, via volume discounts, which favor large, entrenched complementors over new entrants. ISPs can also impose discrimination using deep packet inspection (DPI) to distinguish and prioritize traffic, or limit a class of application via software on an attached device.<sup>24</sup> ISPs could also offer discriminatory terms for physical

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<sup>22</sup> Barbara van Schewick, *Internet Architecture and Innovation* (MIT Press, 2010).

<sup>23</sup> Brett M. Frischmann, *Infrastructure: The Social Value of Shared Resources* (Oxford University Press, 2012).

<sup>24</sup> For example, ATT used a feature in the iPhone software to block use of the FaceTime app for certain data plans. See <http://arstechnica.com/apple/2013/01/att-continues-chipping-at-facetime->



interconnection to complementor networks. The MSP model suggests that all forms of potential discrimination imposed by the platform owner on their complementors should use one regulatory logic, as opposed to viewing physical interconnection through one lens, DPI through another, and so on. The regulatory concern is the discrimination in the business relationship, not the technical approach to implementing discrimination.

Others have used multi-sided market analysis to analyze relationships between complementors and users. Some studies have found possible benefits of discrimination across complementors, such as enhancing overall welfare by charging for advertising to subsidize desirable content from other complementors, or charging content providers for enhanced QoS.<sup>25</sup> Notably, Bourreau et al. acknowledged that it may be in the interest of an ISP to degrade the basic best-effort service, which would warrant regulatory attention.

### 3.3 Peering disputes and pricing analyses

In the last five years we have seen increasingly public debates about whether peering between networks should be revenue-neutral (without financial settlements between peers) or whether paid peering should reflect relative costs to ISPs of carrying traffic, or even reflect manifestations of relative bargaining power. The MSP model suggests that regulatory scrutiny of peering disputes should distinguish two different circumstances: disputes among the firms making up the platform, or discrimination by platform operators on complementors on the platform. A peering dispute between an ISP and a complementor should be subject to the same sort of analysis as any other form of discrimination imposed by an ISP on a complementor.

With respect to peering disputes among firms that interconnect to make up the Internet, such events are characteristic of what can happen in any multi-firm platform. As described by Gawer,<sup>26</sup> in any multi-firm platform a powerful actor can dominate the creation of the platform, or potentially even disrupt it by predatory behavior. In particular, the argument is much weaker that an ISP is situated in an MSP when it negotiates terms for peering with other ISPs than when it negotiates with complementors who need access to users.

Peering disputes with complementors have gained more recent attention, given the increasing number and size of complementors seeking direct associations with

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over-cellular-policy/.

<sup>25</sup> Marc Bourreau, Frago Kourandi, and Tommaso Valletti, Net Neutrality with Competing Internet Platforms, Available at SSRN: <http://ssrn.com/abstract=2061571> or <http://dx.doi.org/10.2139/ssrn.2061571>, 2012; J. Gregory Sidak, "What is the Network Neutrality Debate Really About?," <http://ijoc.org/index.php/ijoc/article/view/177/95>, International Journal of Communication 1 (2007).

<sup>26</sup> Gawer, "Platform Dynamics and Strategies: From Products to Services."



access ISPs, e.g., Netflix and Google. Some access ISPs have questioned the proper balance of pricing and discrimination between a specific class of complementor (content distribution networks) and users, arguing that distributors of content should pay if they want to connect directly to the ISP's customers.<sup>27</sup> This situation is a classic example of a pricing analysis in an MSP; rather than one class of participant, the end-consumer, covering the costs of the access ISP, an alternative is to extract some of that revenue from another class of participant, such as the complementors. This alternative exists independent of whether the access ISP has market power, although a regulatory analysis will certainly consider the implications of market power on the effects of such an alternative.

What are the implications of shifting the balance of payments between users and complementors of the access ISP? It is unreasonable to assume that the ISP could exercise precise first-degree price discrimination and charge each complementor a price that reflects their willingness to pay, given both its impracticality as well as the likely reaction from the market and the regulators. A more likely approach is for the access ISP to charge complementors per bit of data generated by the service, which might drive out of the market complementors with low or unproven value. On the other hand, if this shift significantly drove down the price charged to users, more users might enter the market. A recent illustration is Facebook's deals to pay certain mobile carriers to provide users free access to Facebook via their cellular devices.<sup>28</sup>

We know of no fundamental principle that determines an optimal balance; even reasoning about it requires empirical data such as cost and price elasticity. However, the complexity of the MSP landscape implies that ISPs contemplating a shift in their negotiating position about interconnection with complementors should not consider the shift only as a new source of revenues. Even non-discriminatory prices charged to complementors, if high enough, could chill innovation. Lower prices may benefit innovation and public good creation more than the total absence of discrimination, especially in the complementor market.

### 3.4 Discrimination with respect to retail users

As a prelude to the rules promulgated in the Open Internet Report and Order, and to frame the FCC's regulatory objectives to "ensure that broadband networks are widely deployed, open, affordable, and accessible to all consumers", the FCC published four principles:<sup>29</sup>

To encourage broadband deployment and preserve and promote the open and interconnected nature of the public Internet, consumers are entitled to

- access the lawful Internet content of their choice,

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<sup>27</sup> Sean Buckley, "Cogent and Orange France fight over interconnection issues," *Fierce Telecom* (2011).

<sup>28</sup> See <https://www.facebook.com/notes/facebook/fast-and-free-facebook-mobile-access-with-0facebookcom/391295167130>, visited 13 August 2014

<sup>29</sup> Federal Communications Commission, FCC 05-151, Policy Statement In the matter of Appropriate Framework for Broadband Access to the Internet over Wireline Facilities, CC Docket No. 02-33, etc., " [http://hraunfoss.fcc.gov/edocs\\_public/attachmatch/FCC-05-151A1.doc](http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-05-151A1.doc) ", 2005.

- run applications and use services of their choice, subject to the needs of law enforcement,
- connect their choice of legal devices that do not harm the network,
- competition among network providers, application and service providers, and content providers.

The first two principles, without using the language or framing of an MSP, frame a two-sided analysis, looking at the consequences for the consumer (one class of participant) of discrimination on another class (complementors—providers of content and applications). The third principle directly protects users from one form of discrimination, and the fourth principles offers a bit of wishful hoping for competition. But the only direct protection of the user from discrimination is that the consumers can attach devices of their choice. There is no requirement that all potential users be served, or served at the same price.

In fact, ISPs today do discriminate with respect to what consumers can do. One common limitation is that residential users are not allowed to attach a "server" (device) to their network. This restriction might fall within the "reasonable network management" exception on a cable system with limited upstream capacity, but when Google imposed the same restriction on their Kansas City service with abundant upstream capacity, they received criticism.<sup>30</sup> Another view is that the limited protection given to the consumer by the four principles was intentionally constructed to allow ISPs to stratify their users into classes, e.g., residential vs. business.

With respect to pricing, most wireline ISPs do not differentially charge users based on what they are doing. Rather, they offer either flat pricing or usage caps. These billing models are a form of discrimination: customers with low usage support those with higher usage. The benefit to this form of discrimination is that for any individual user, the incremental cost of trying some new service from a complementor or engaging in an activity that generates mostly a public good (e.g. the user does not appropriate the benefit) is zero. In contrast, wireless plans that impose usage caps and tiers may inhibit experimentation and participation in activities where the value that accrues to the user is (perceived to be) low.

### 3.5 MSP behavior in more mature markets

Another consequence of applying MSP theory relates to saturation in one side of the market. According to MSP theory, when platforms compete (as with IP vs. another protocol suite) in a growing market, innovation by complementors brings value to the platform owner in the form of network effects that lead to success of the platform. This dynamic applied in the early days of the Internet. But once the platform (as an interface or standard) has achieved market dominance, and

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<sup>30</sup> Ryan Singel, *Now That It's in the Broadband Game, Google Flip-Flops on Network Neutrality*, <http://www.wired.com/threatlevel/2013/07/google-neutrality/>, 2013.

especially if the pool of users saturates, as it seems to be doing for wireline broadband access, the logic of the MSP may cease to explain the benefit to the platform provider of more complementors (i.e., apps). Indeed, with current wireline pricing models that bring little or no additional revenues with additional usage, new complementors that drive increased usage bring negative value to the platform provider. Alternatively, usage tiers may encourage investment in capacity, and thus the addition of new complementors, but at the same time discourage the use of these complements by cost-conscious users.

## 4 Shaping consistent regulation based on layered MSP model

Our repeating layer model captures the idea that a given actor (e.g., an ISP) may produce many platforms as part of their system design. We have focused on three platforms that appear or are likely to be stable in the ecosystem: the global Internet, the single-firm IP platform, and a multi-firm IP platform. We have also explored how the theory of multi-sided platforms can shed further light on the behavioral influences of and on platform owners, complementors, and users. Assuming that regulation attached to stable layers will likely be more durable, we now consider how the framework we have developed can help scope consistent policy and regulation of the Internet. We examine three open issues and what light platform theory sheds on them: one short-term regulatory quagmire (specialized services), one medium-term policy challenge (minimum quality regulations), and one long-term philosophical debate (structural separation).

### 4.1 Consistent regulation of services on different IP-based platforms

Regulators, when looking at the structure of the market, may look at the overall behavior of firms, or at the desired qualities of a platform. Put differently, when should a regulator consider a platform in isolation, as opposed to considering a firm's treatment of several platforms? MSP theory suggests an answer to this question: platform layers merit a unified analysis if they serve the same classes of participants. Whether the platform is single-sided and serves one class of participants, or an MSP that serves multiple classes, if two platforms can serve the same classes then they should be considered jointly. As a specific example, if a collection of access ISPs offers their multi-firm IP platform as an alternative industry platform to many complementors to reach consumers, the single-firm and global Internet platforms are alternative means to serve the same classes of participants, and merit joint consideration. In contrast, an access ISP might use its single-firm MPLS platform layer to offer an "Ethernet-over-MPLS" service to allow a multi-site enterprise to connect its various sites; this type of enterprise constitutes a different class of platform participant, and thus this platform merits independent consideration from an MSP IP platform. Note that joint consideration of platforms does not imply equal treatment. For example, the single-firm IP platform as an

industry platform for complementors might seem to serve the same participants as the global Internet platform, but it imposes extra burdens on potential complementors: it serves only directly connected complementors, which might require a different regulatory analysis.

Entanglement among platforms potentially arises if they serve some but not all of the same participant classes. As with the Xfinity Xbox service (Section 2.1), an access ISP could use its internal single-firm IP platform to offer a video service to consumers, i.e., resell video content over that platform, which competes with a video service offered by a third-party complementor over the global IP platform. The services over the two platforms (single-firm IP and the Internet) have the retail user in common as a class of participants, but they do not involve the same classes of participants: with carrier IPTV, the ISP is acting as a reseller of video programming, not as an MSP. Any entanglement of regulatory consideration would derive from the fact that services over both platforms offer competing and similar offerings to one class of participants. In the Open Internet Report and Order,<sup>31</sup> the FCC specifically concluded that this sort of IPTV was not covered by the requirements of the order.

The FCC tried to address the reality of services offered over multiple platforms by using the term "specialized services" in the Open Internet Report & Order to exempt certain services from the Order.<sup>32</sup> Like many other terms introduced to describe new behaviors that do not fit into the prevailing model of industry behavior, the term "specialized services" brings little clarity to what is happening. The FCC identified carrier IPTV as a specialized service (e.g., IPTV running over the single-firm IP platform of the provider, although they did not use this terminology or framing), but the more general and unresolved question is when to classify a service as a specialized service. The FCC's current position (not further clarified in the May 2014 NPRM) is that the distinction is determined by the set of machines reachable via the service.<sup>33</sup>

However, the multi-firm IP platform that carries VoIP services for the facilities owner will likely ultimately have a global scope, and is not currently subject to neutrality rules. Our test of whether the platforms serve the same classes of participants may yield a cleaner signal. The Open Internet Advisory Committee (OIAC) looked in detail at different definitions of "specialized services" and different criteria that might be used to exclude a service from regulatory requirements.<sup>34</sup>

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<sup>31</sup> Federal Communications Commission, Report and Order, Preserving the Open Internet, FCC10-201.

<sup>32</sup> *Ibid.*

<sup>33</sup> *Ibid.*, para. 47.

<sup>34</sup> The OIAC recommended three principles to guide the consideration of specialized services: (1) *Open Internet regulation should not create a perverse incentive for operators to move away from a converged IP infrastructure;.. (2) A service should not be able to escape regulatory burden, or acquire a burden, by moving to IP;.. (3) Proposals for regulation should be tested by applying them to the range of technologies being used for broadband... These seem like simple statements, but in fact they may have very powerful consequences. They are an attempt to bound the scope of regulation without the need to debate the definition of any terms such as specialized services* Open Internet Advisory Committee, Federal Communications Commission, Open Internet Advisory Committee 2013 Annual Report, <http://transition.fcc.gov/cgb/ojac/ojac-2013-annualreport>. pdf, 2013, pp. 66-71.

## 4.2 Regulating the platform itself rather than the platform provider

The previous section described an approach to regulation in which the regulator imposes requirements on a firm, perhaps across several platforms, to limit its behavior with respect to various classes of its participants, such as complementors. An alternative is to regulate a specific platform, with the goal of sufficiently satisfying high-level social goals (e.g., high performance, low cost, complementor innovation) so that regulation of other platforms of the firm is not required. Such platform regulation will attempt to ensure that the player with power (the platform provider) is working for the overall good of the ecosystem. But the higher-level question remains: what goal might warrant regulatory intervention? If the goal is to drive healthy innovation, then if the global Internet is "good enough" to stimulate complementor innovation, it matters less what the provider does with its single-firm IP platform. In other words, the higher performing and lower cost is the global Internet offering, the lower the regulatory interest should be in activities on the single-firm (or multi-firm) IP layer. (This approach raises the question of how to define minimum quality standards, which others have already recognized as a potential anchor of future regulation.<sup>35</sup>)

The traditional discourse on network neutrality (and specifically in the U.S., the FCC Open Internet principles) approaches this question primarily by constraints on the Internet offering itself.<sup>36</sup> But the alternative platforms, particularly the single and multi-firm IP platforms, increase the degrees of freedom both for an ISP and for the regulator. Any theory of regulation that argues for limitation on the activities of the platform owner must take into account the degrees of freedom that the platform owner has. For example, imagine that a platform operator (broadband provider) allocates a share of the IP platform as an alternate, logically separate, multi-firm industry platform, which is IP-based, but not interconnected with the public Internet. On that share, the platform operator allows third-party complementors to offer consumer-facing services, perhaps with superior qualities compared to the public Internet (e.g. QoS), or may curate the library of available applications like the Apple app store. A theory of regulation should be able to explain why this business behavior is pro-innovation or anti-competitive, pro-consumer or not. Under these circumstances, is it appropriate to constrain the Internet service relative to what is legitimate on a different platform serving the same participants? The MSP analysis can illuminate debate of these sorts of questions. It may reveal, given the degrees of freedom to both actors to use alternative platforms to evade regulations, that a better regulatory approach is to offer incentives to the ISP to improve the global Internet platform, as described, rather than constraining its operation.

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<sup>35</sup> Tim Brennan, Net Neutrality or Minimum Quality Standards: Network Effects vs. Market Power Justifications, [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1622226](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1622226), 2010; kc claffy and David Clark, "Workshop on Internet Economics (WIE2012) Report," ACM SIGCOMM Computer Communication Review (CCR) (July 2013).

<sup>36</sup> Section 3.4 and Federal Communications Commission, FCC 05-151, *Policy Statement In the matter of AppropriateFramework for Broadband Access to the Internet over Wireline Facilities*

### 4.3 Open interfaces and structural separation

Finally, we use our multi-sided platform model to compare options for a more radical approach to industry regulation. In platform terms, structural separation is a requirement that the owner of platform use it only for third-party complementors, but not as an internal platform for deploying higher-level services. Structural separation is an extreme form of facilities unbundling; in simple unbundling, the owner of the platform must make it available to any comer on non-discriminatory terms, but is also allowed to use it as an internal platform on the same terms.

As a real-world example, the British regulator has imposed structural separation on the physical layer platform of British Telecom (BT). BT was required to establish a separate firm, Open- Reach, to own and operate the actual copper pairs. In this paper we have not emphasized the platform represented by the physical layer, but it is indeed a durable layer and thus a reasonable target of regulation. BT itself is also required by the regulator to internally separate their wholesale and retail market, and to provide an open interface between the two, to which competitors may attach. BT is not prohibited from using this interface–this is not a point of structural separation, but a mandated open interface. This open interface is at the top of the BT single-firm IP platform. See Figure 8.

Different layers raise different issues as open platforms. Several aspects of the physical layer make it a challenging target of structural separation regulation. First, this layer depends on technology choices. It is difficult to imagine a technology-neutral form of structural separation at the physical layer. Second, using copper pairs as an example, there is no simple way to share a copper pair between two competitors offering the same service, e.g., access to the public Internet. A given consumer will pick among competing providers of higher-level services, but then must obtain all services from that one physical-layer provider. The resulting market structure could limit competition among complementors.

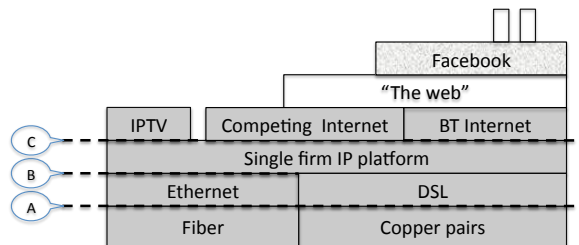


Figure 8: *Single-firm industry platforms provided by British Telecom (BT), illustrating a distinctive regulatory approach. The platform labeled “A” is a point of structural separation between BT and the company (Open Reach) holding the physical assets. The “B” and “C” platforms are regulated industry platforms, i.e., open to competitors, but not points of structural separation. The “C” platform, BT’s single-firm IP platform, is available to those who want to offer a competing retail Internet service. The “B” platform allows competitors to obtain point-to-point links to connect parts of their network.*

Imposing a separation point at a higher-level platform layer would allow more flexibility in the resulting market structure. In particular, separation at a layer that



allows multiplexing among multiple complementors (e.g., a packet-switched platform) could allow multiple complementors to offer services to the same participant. The BT open interface at the single-firm IP layer does not provide this option.

We are not advocating structural separation, but rather showing how multi-sided platform and multi-platform analysis could help to answer the important question in any debate over structural separation: what are the implications for the platform owner and the larger ecosystem if the owner were precluded from using it as an internal platform?

#### 4.4 Summary: How the MSP model informs regulatory options

The last three sections have discussed regulatory approaches to dealing with the reality that the ISPs have alternative platforms over which to offer services; we might call these approaches the *stick*, the *carrot* and *induced competition*. In their Open Internet Report and Order,<sup>37</sup> the FCC took the stick approach, i.e., the regulator would impose the same regulations on any services that it finds to be "functionally equivalent" to the same provider's broadband Internet access service. In the carrot approach, which both the European Parliament<sup>38</sup> and the FCC's Open Internet Advisory Committee<sup>39</sup>, have explored, the regulator considers whether the Internet service offering is good enough (although "good enough" is not defined), without concern for other offered services. In the induced competition approach, structural separation and open interfaces induce a competitive marketplace of providers of the public Internet platform, requiring less regulation of the platform itself. For example, structurally-separated BT (Figure 8) faces both retail and facilities-based competition, and exercises substantial traffic management discrimination, which it claims benefits the consumer and thus provides BT a competitive advantage. In this case, the regulator uses structural separation to impose market discipline rather than regulating neutrality at the Internet layer. Applying MSP framing to our platform models facilitates analysis of these options, providing a basis to argue whether two platforms should be considered jointly, to ascertain which participants would be harmed if the platform were not "good enough", and to explore which platforms to consider as candidates for open access.

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<sup>37</sup> Federal Communications Commission, Report and Order, Preserving the Open Internet, FCC10-201, para 44.

<sup>38</sup> Parliament, *European Parliament legislative resolution on the proposal for a regulation of the European Parliament and of the Council laying down measures concerning the European single market for electronic communications*, pg. 37: "Providers of content, applications and services and providers of electronic communications should therefore continue to be free to conclude specialised services agreements on defined levels of quality of service *as long as such agreements do not impair the general quality of internet access services*". (Emphasis added.)

<sup>39</sup> Open Internet Advisory Committee, Federal Communications Commission, Open Internet Advisory Committee 2013 Annual Report, pp. 66-71

## 5 Conclusions and future directions

We have presented a model that characterizes both the layered platform architecture of today's communications technology, and aspects of interconnection among firms to produce the global Internet and its connected complementors. We have identified three specific IP-based platforms as important: the single-firm IP platform, the global Internet, and a multi-firm private IP platform. These platform layers are more stable fixtures of the infrastructure than other layers beneath or above them, and thus a focus on these specific layers will help produce policy that is durable in the face of rapidly evolving technology and business models. We have described how peering among firms that make up the global Internet raises different issues than interconnection between a complementor and the Internet, and distinguishing them is fundamental to analysis of Internet interconnection issues.

We believe the model we propose suggests several fruitful directions for current ICT policy debates, and we touch briefly on three examples: specialized services, minimum quality regulations ("the dirt road" problem), and structural separation. We would like to see a deeper debate on each of them. Can the platform model help clarify a definition of specialized services, or scope minimum quality regulations? With respect to the question of whether behavior on different platforms should be evaluated independently, an auspicious starting point is to determine the extent the two platforms serve the same class of participants.

With respect to structural separation, the model also allows comparison of likely business consequences of mandating open access to the physical layer, the IP layer, or the public Internet layer, as well as predicting possible outcomes to expect from platform owners if regulators impose limits on the single- or multi-firm IP platform.

Our model also suggests opportunities for discrimination on multi-sided platforms, both with respect to users and to complementors. These include pricing discrimination (some of which we see today, such as volume discounts and flat rate pricing), discrimination in interconnection policy, and manipulation of traffic flows based on their characteristics, including which users or which complementors generate the traffic. The model also provides a consistent framework to analyze all forms of discrimination with respect to a given class of participant (e.g., a complementor), as opposed to looking at (for example) interconnection using one framework and traffic-based discrimination using another. Because the model allows us to describe the evolution of significant stable aspects of the ecosystem, we believe it will be a useful tool for ICT policy analysts.



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